R. A. Lee.
Pt= 21

Post Office telecommunications journal

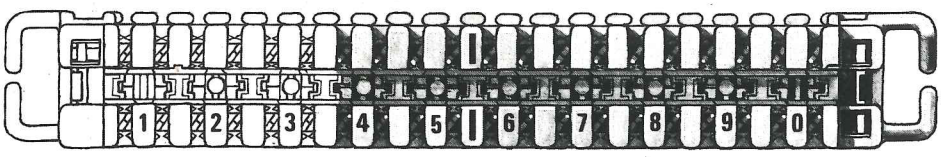
Summer 1979 Volume 31 No. 2 Price 18p

TELECOM 79
Geneve 20-26 Sept. 1979

Special preview: See pages 16 and 17

KRONE

The Company that believes good connections are not who you know but what you make



When it comes to making good connections for telecommunication systems, Krone is the specialist.

Indeed since 1928 when Gustav Krone, the Company's founder, introduced a revolutionary new technique in terminations, Krone has never stopped contributing to the world of advanced telecommunications with its design, technology and high-quality manufacturing standards.

Today, the Company supplies many of the World's leading postal authorities with a complete range of modern line plant equipment.

Typical are the LSA Systems (contacts not requiring soldering, screwing, or wire-stripping) of which the newest version is the LSA-PLUS.

If you'd like to know more about us, give us a call. It's the first step to better connections.

The illustration depicts an LSA-PLUS Connection Strip for 10 Pairs, actual size.

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The basic frame-work with:—

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- **fanning strips**
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All you need tell us is the code for the framework required or, failing that, just tell us the size and the number of lines: we'll tell you the rest.

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- **Tie Bars**
- **Cable Runways**
- **Bus Bars**
- **Clamps**
- **Brackets**
- **etc.**

and would be pleased to advise you on your layout and installation.

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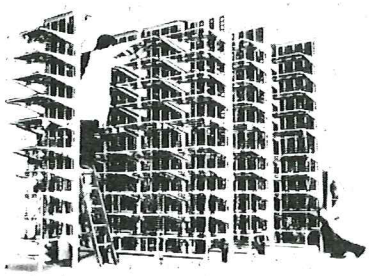

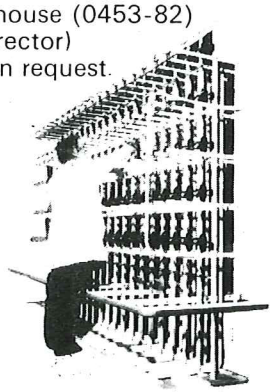

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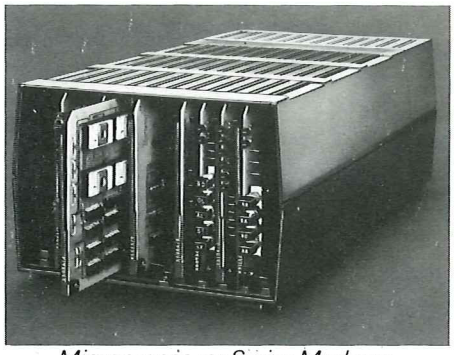
We currently supply to: BPO · Plessey · Standard Telephones and Cables · GEC · PYE TMC · Thorn Ericsson · Cable and Wireless · International Air Radio Electricity Boards and Gas Boards.

Modem MPS48 is the first of a series of Racal-Milgo high speed modems employing purpose-built microprocessors. Operating synchronously at 4800 bit/s over 2-wire or 4-wire voice grade telephone lines, the MPS48 can be used in point-to-point, multi-drop and dial-up configurations, including dial back-up.

The specially developed powerful microprocessors allow extremely fast and accurate automatic line equalization and detection of received data. In fact, the unique equalization sequence gives an astonishingly short request-to-send/clear-to-send delay of 26 milli-seconds for 4800 bit/s operation. This, combined with the ability to equalize on incoming data, makes the MPS48 eminently suitable for use in multi-drop polling applications.



Microprocessor Series Modems.

The MPS48 has a mind of its own.

Modem MPS48 has a complete range of diagnostics, including self-test, remote test and plug-in options for point-to-point and multi-drop operation. These give increased performance with minimum downtime. Other plug-in options include a low speed secondary channel and dual 2400 bit/s channel capability. The new modem is compatible with Modem 27LSI, in point-to-point systems and complies with CCITT recommendation V27.

Modem MPS48. With a mind of it's own, it's well worth looking into. Write to the address below for full details. Racal-Milgo Limited, Bennet Road, Reading, Berkshire, RG2 0SS England. Telephone: Reading (0734) 85282 Telex: 847667

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We're not given to making extravagant claims.

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Just give us 45 minutes and we can modify it to suit our Telexcutter 4000 system.

Which means your typewriter also becomes a telex punch keyboard.

YOUR TYPIST.

YOUR TELEX ROOM.

We've brought the telex up to date.

You can prepare telex messages in any office, anywhere in the building whilst the heart of the system punches out the tapes in the telex room.

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(Unlike the telex which transmits correction codes. At your expense, we might add.)

And you'll save on typing the same message twice. Once in the office, and once in the telex room.

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Now think of the time and money this saves. Then multiply it by eight. Because the Telexcutter can link inputs from up to eight separate typewriters. Or computers. Or V.D.U.'s. In any combination.

Free trial without strings.

We think it's the best system available. We'd like you to judge for yourself. In your office. At our expense. We'll even bring our own typewriter.

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I'd like to see it in action. Call me to arrange a time.

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POTJ 8/79

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Versatile business communications systems, including P.A.B.X.'s from 4 to over 5,000 lines using digital switching and stored programme control.

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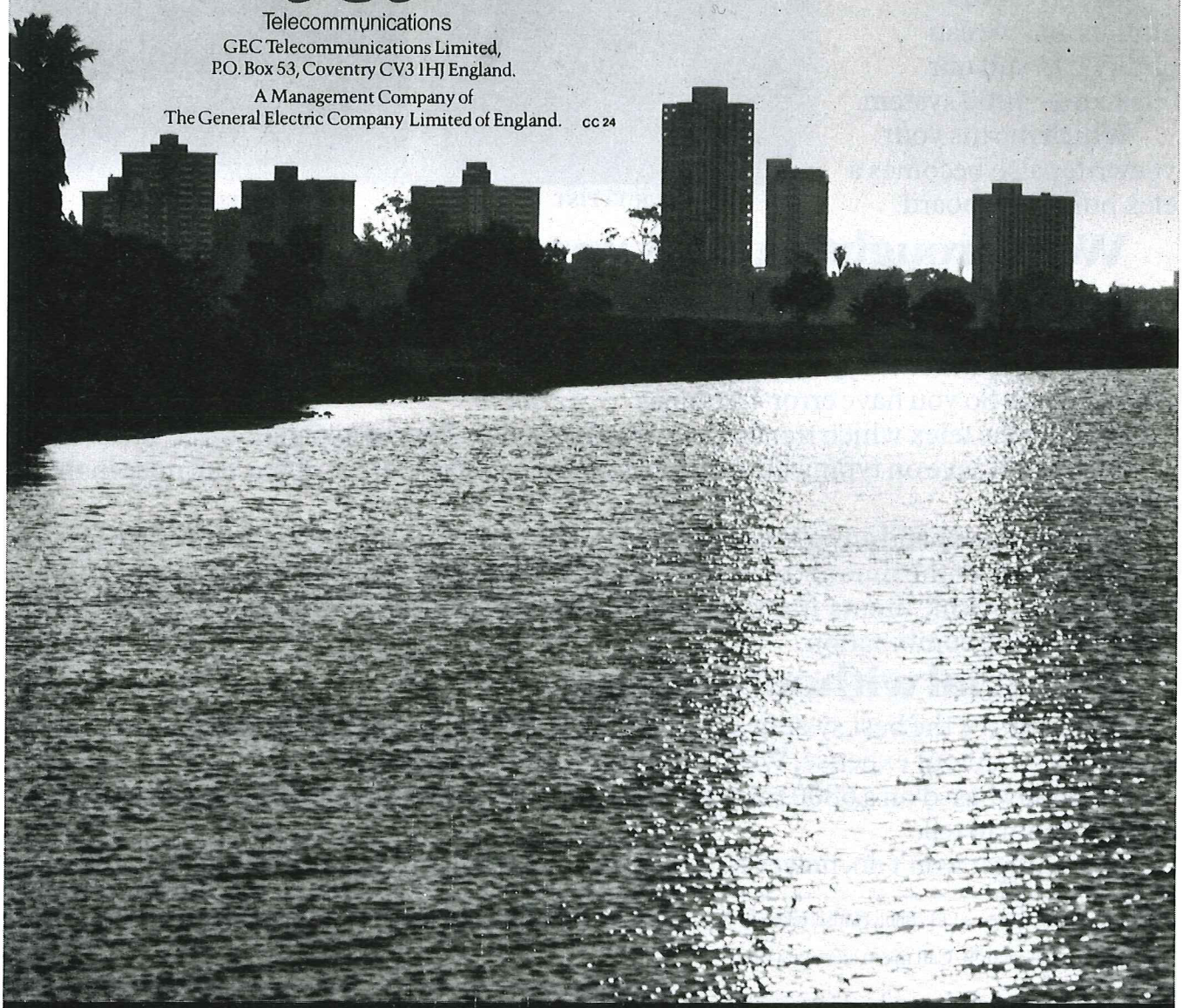
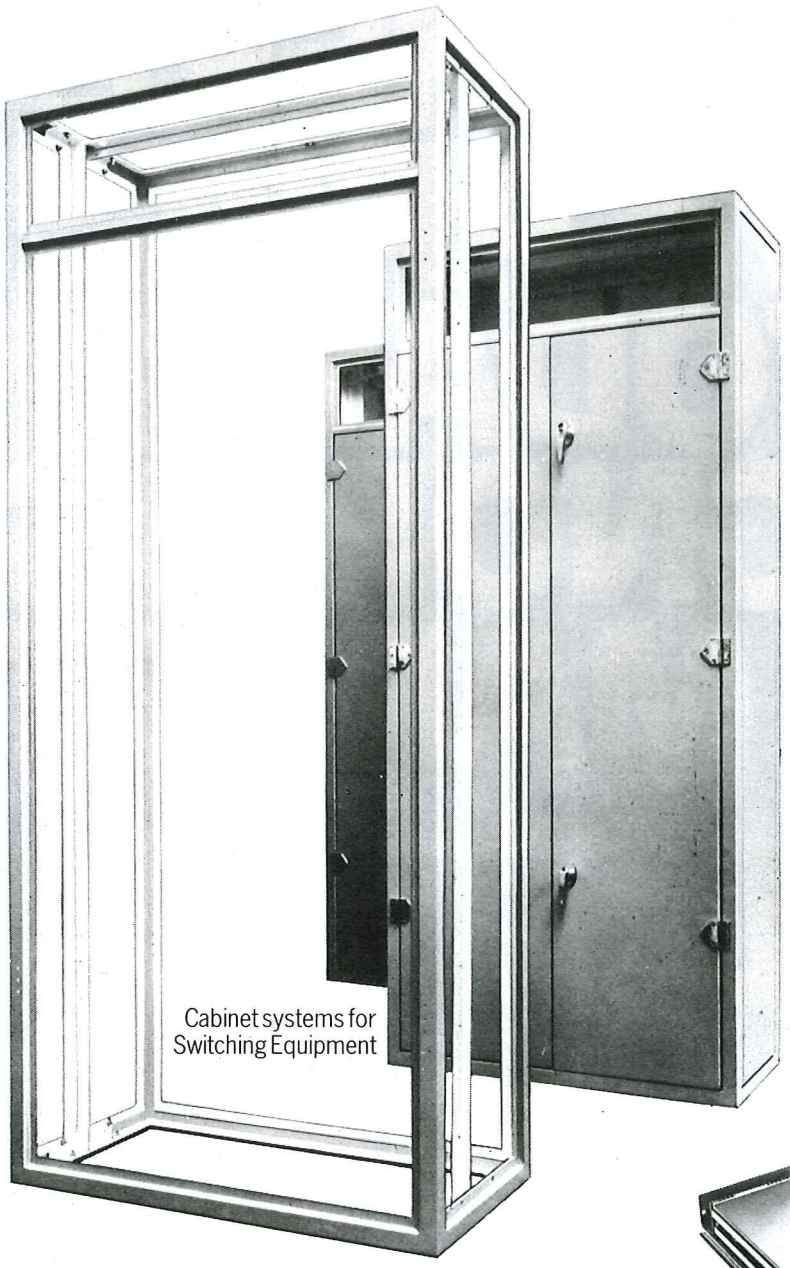


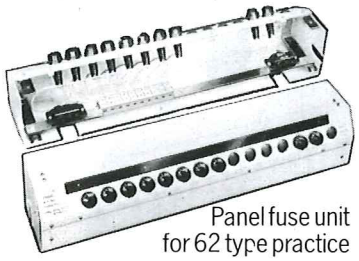
See us on Stand 472, Hall 4.
GENEVA 20-26 SEPTEMBER

TELECOM 79

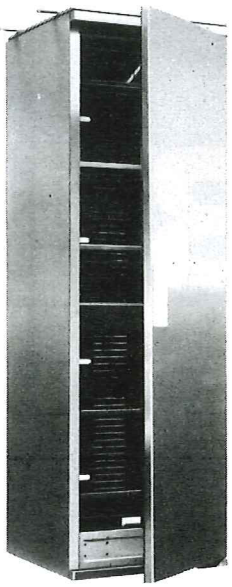
The Post Office approves, so will you!



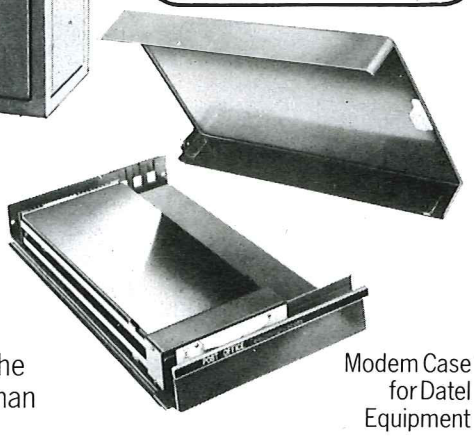
Cabinet systems for Switching Equipment



Panel fuse unit for 62 type practice



73B1 Cabinet containing 62 type rack



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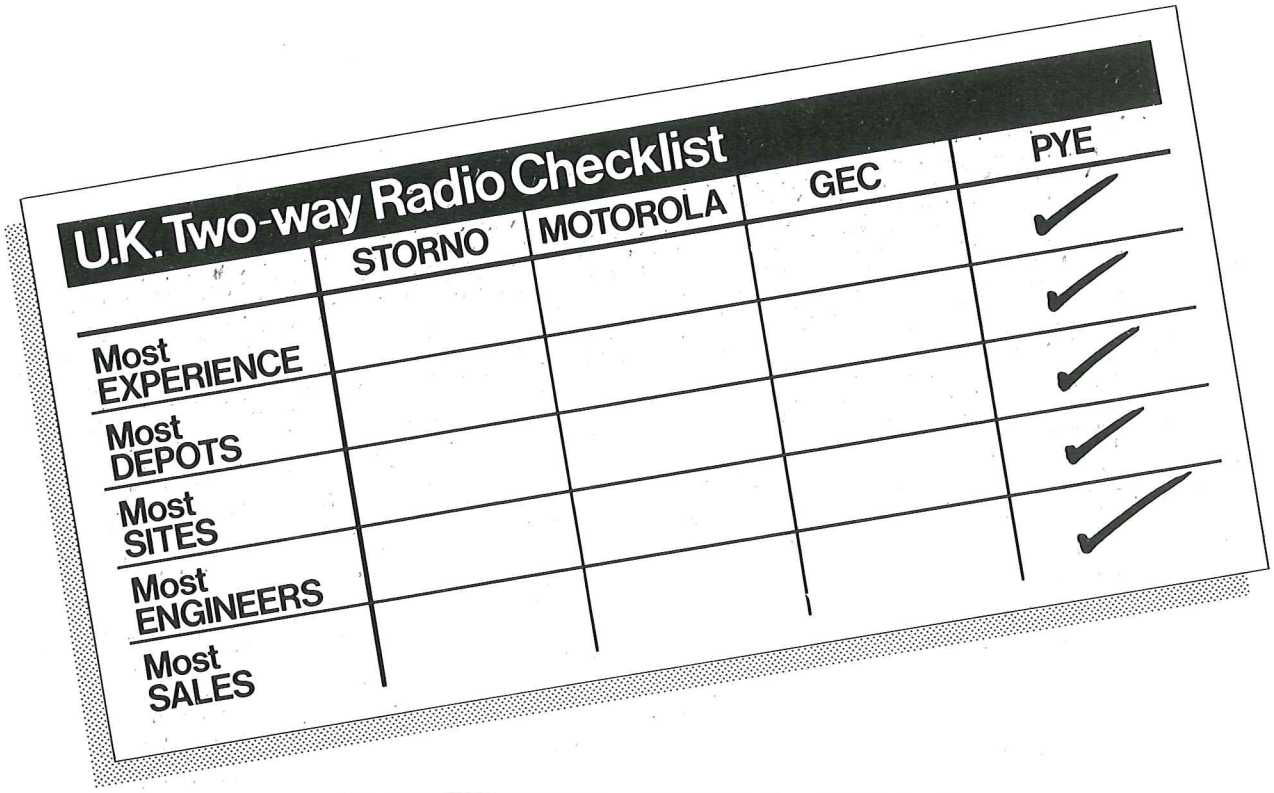

OK

But what does it all add up to?

Big is not always beautiful.

So when we boast more resources than all our competitors put together you might be inclined to think: so what?

We agree.

When *you* are making substantial investments in two-way radio we expect more than facts and figures to be taken into account.

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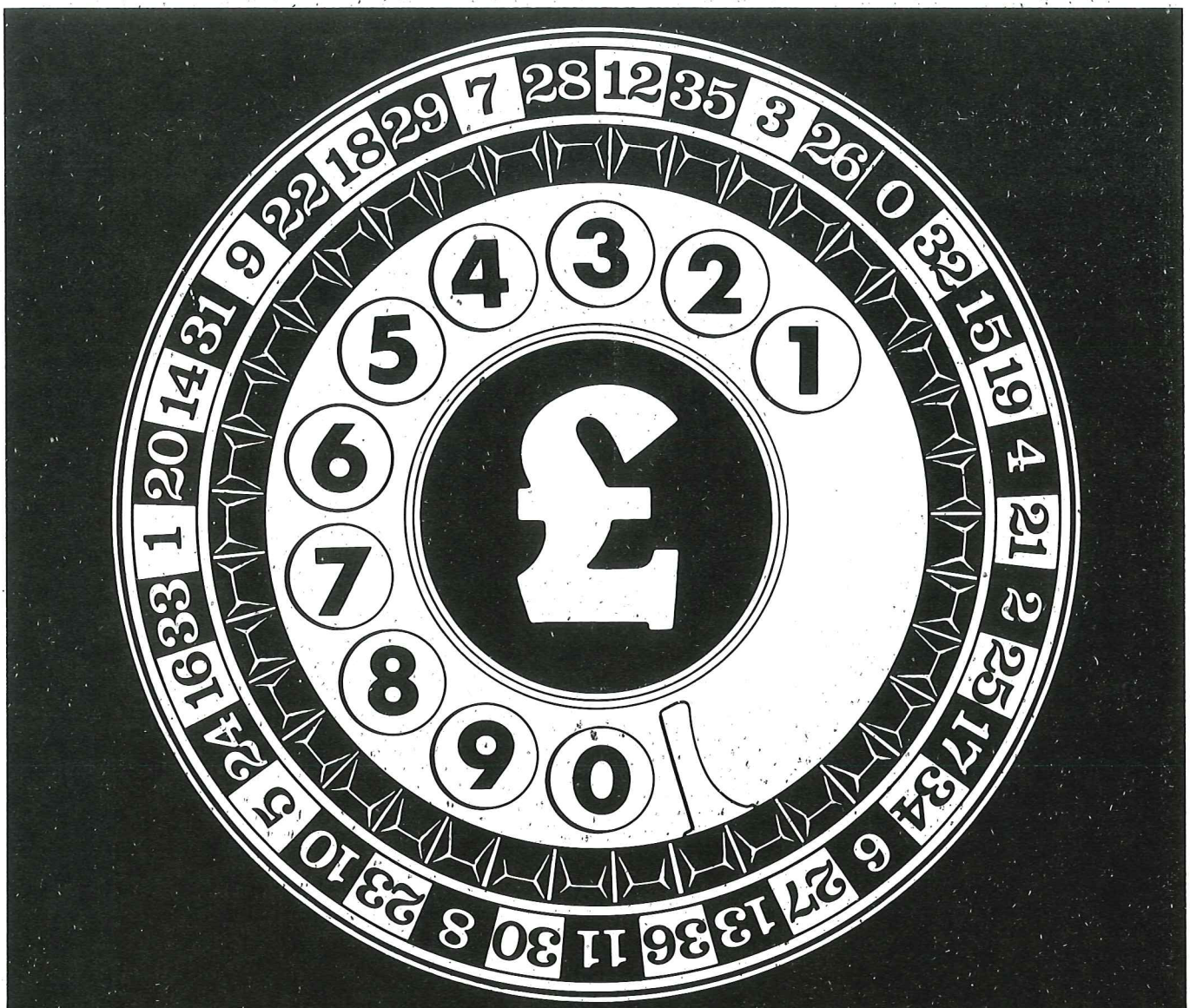
Telephone: 0223 61222



Tel-Tag is a sophisticated telephone management and information system.
Tel-Tag will record all the telephone calls made within your organisation and indicate for each call who made it, when it was made, where to and, most importantly, at what cost.
Tel-Tag provides detailed financial and statistical reports from the analysis of the information it has collected and additionally provides instantaneous readout of the calls taking place. From this you can determine the efficiency of your telephone system, where major savings can be made, and how to overcome serious bottlenecks.
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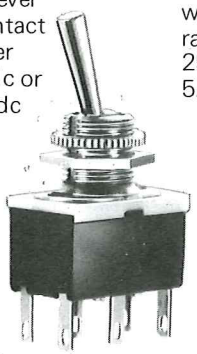
Already the Arrow-Hart Plymouth plant is fully BS 9000 approved. All the Arrow switches listed below have been approved too. We want you to be confident the switches you specify will meet the new standards . . . then you'll be right in line with latest European requirements. So *be sure* . . . from now on choose from these world-recognised Arrow ranges.

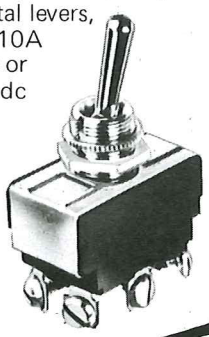
...with these popular Arrow ranges...

Subminiature BCT & FCT series, rugged low-cost metal lever switches rated to 3A 250V ac or 5A 30V dc.

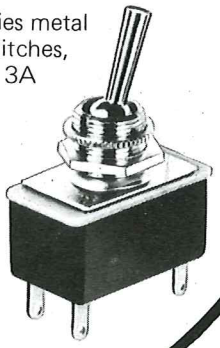
Duty-choice B125G & B125U series, metal lever switches. Contact variations offer 1A 250V ac/dc or 0.1A 30V ac/dc for low level switching.



AC only switches in the B93 & F93 series, with metal levers, rated at 10A 250V ac or 5A 30V dc



B81 series metal lever switches, rated at 3A 250V ac or dc



Arrow Hart

always thinking ahead

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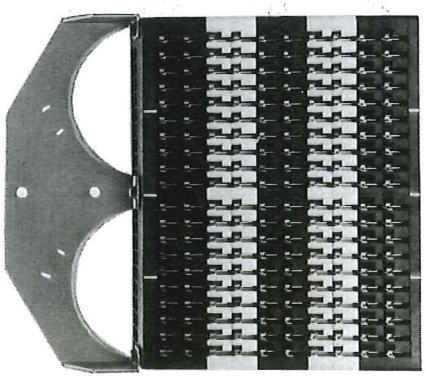
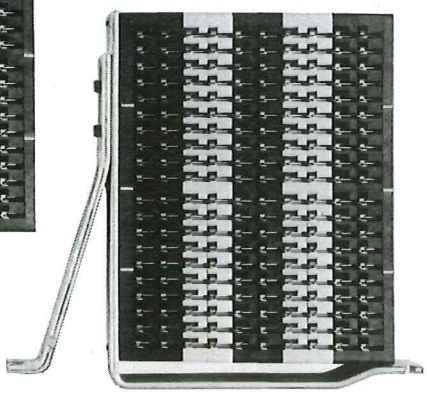
x

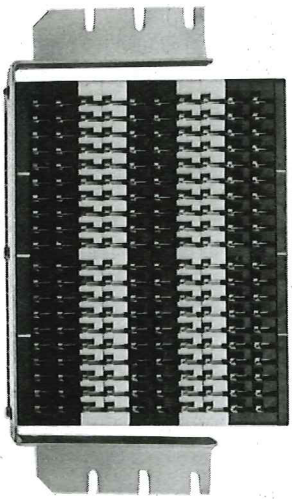
M.D.F termination



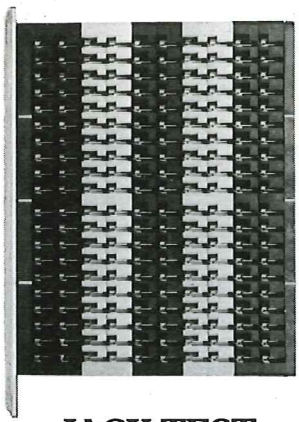
JACK TEST
37/1A



JACK TEST
37/1B



JACK TEST
38/1A



JACK TEST
38/1B

Jacks Test Nos. 37/38/41A

Jacks Test Nos. 37/38 provide 100 pair termination with test access for the lineside and exchangeside of Main Distribution Frames. Jack Test No. 41A is designed for mounting directly on British Post Office PBX frames.

This range supersedes Fuse Mounting No. 10064 and Jack Test No. 33 and fixings are compatible.

Cable connection is made to wire-wrap tags and jumper wire connection to solder tags. The cable and jumper tags are aligned in planes separated to permit adequate access for wire wrapping and soldering operations.

Jacks Test Nos. 37/38 enable a 3200mm (10ft 6in) rack type MDF to accommodate up to 1000 pairs on each side of the vertical. Mounting brackets are suitable for immediate bolting to pre-rack and rack type MDFs as well as PBX frames.

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100 pair termination units, pre-wired to Protector Mounting No. 4A with socket access for 3 electrode gas discharge tubes (Protectors No. 14A), protect switching equipment from potentially damaging high voltage surges on subscribers' and junction lines.

Protector Mounting No. 4A

Available separately, this unit is for retrospective wiring to Jacks Test Nos. 37/38/41A to convert them to Jacks Test Nos. 39/40/42A respectively.

Birkbys Plastics

a member of the **PLESSEY GROUP**

Birkbys Plastics Limited, PO Box 2, Liversedge, West Yorkshire WF15 6QA.
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TITLE: _____

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Please send me further details of the Jack Test range.

Birkbys Plastics Limited, PO Box 2, Liversedge
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Ferranti Codec for digital conversation.

Designers of telecommunication systems can now enjoy the advantages of Ferranti technology in Codecs.

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It means you can have a single channel Codec circuit that reduces components to a minimum.

We developed our Codec in close collaboration with the Post Office, primarily for their Customers Digital Switching System (CDSS1), but it is equally suitable for application to other telephone switching systems.

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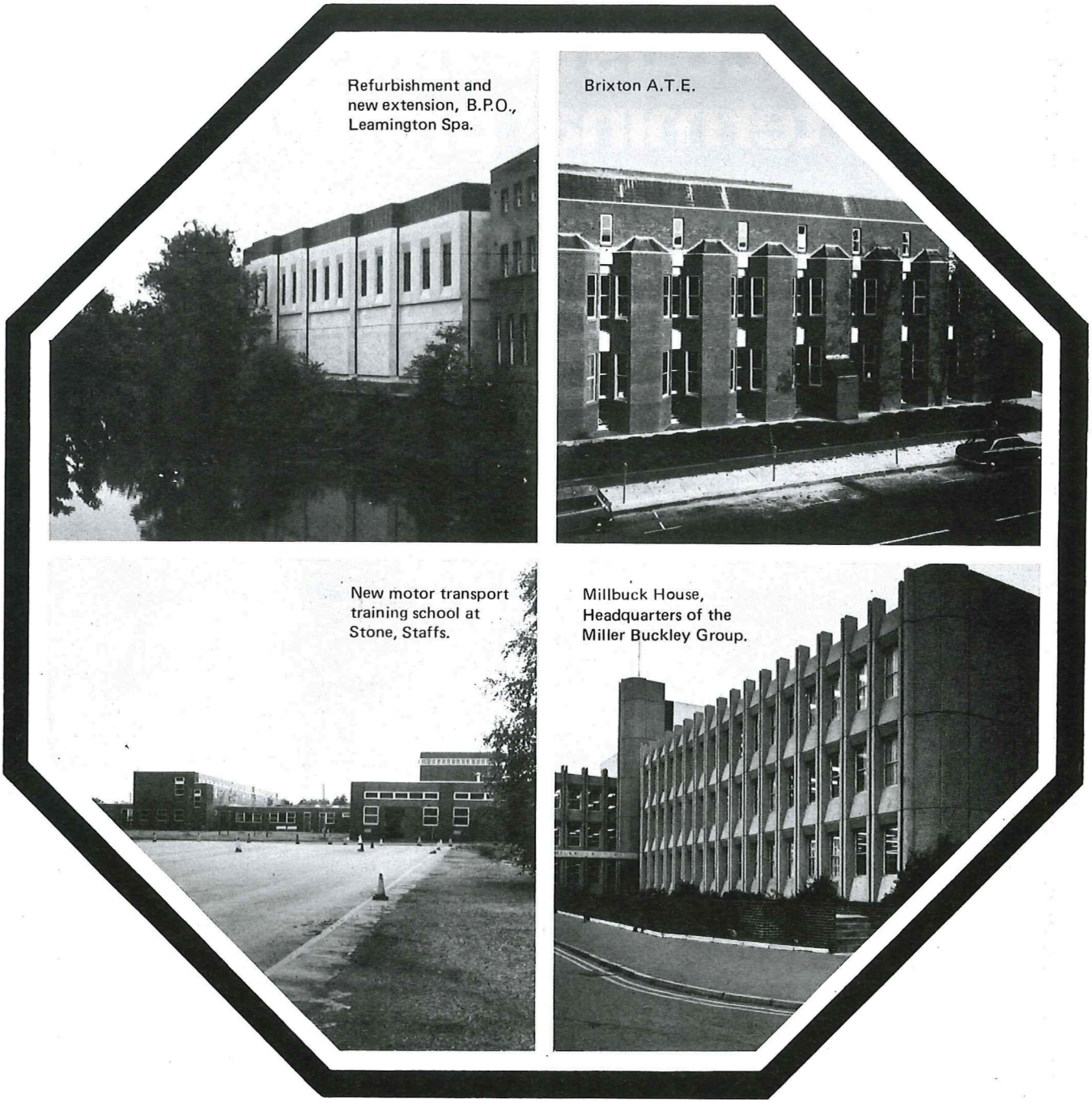

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TELCAS
(Patent Pending)

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Applications are many, and they include allowing companies to keep an account of all calls made by their representatives from private telephones on their behalf, as a replacement for patch meters on large PABX installations, cost accounting on small switchboards, payphone applications, private wire monitoring, and a host of others.

The equipment is fully approved by the British Post Office, and line connection is by means of a standard plug and socket. The machine operates automatically, and it incorporates such features as a disconnection alarm and a standby power supply.

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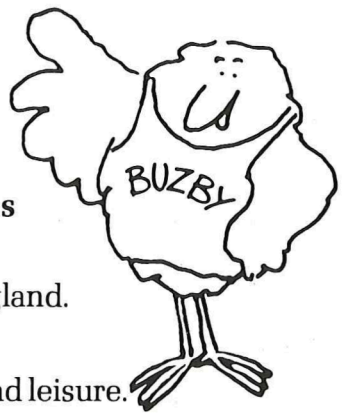
for the Post Office Datel 2412 service.
These are being delivered from our Feltham factory
at a rate of over 400 a month.
A good indication, you will agree, of the quality and reliability
of EMI modems and of the development,
manufacturing and technological resources behind them.
When it comes to modems, talk to EMI. We deliver.

EMI Technology



For details of the EMI modems range, from 200 bps to 9600 bps using LSI and microprocessor techniques, contact:

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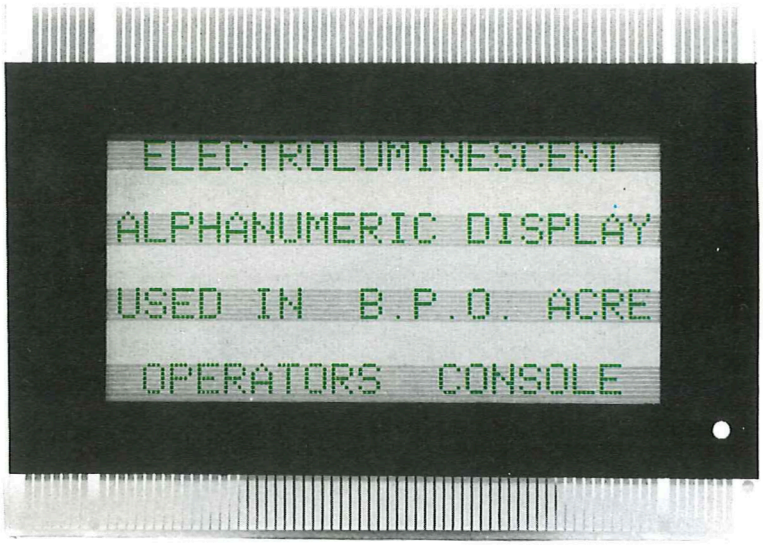

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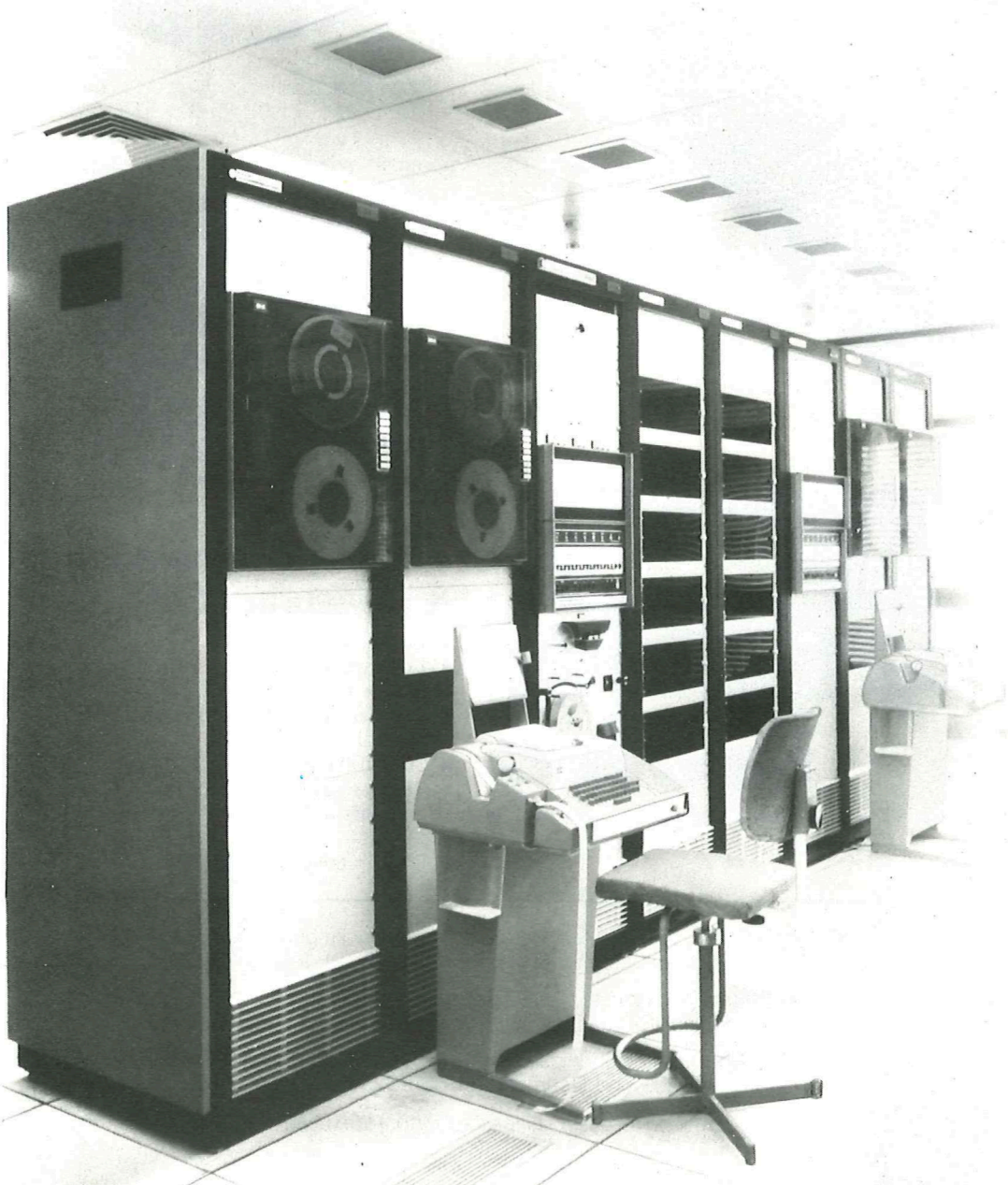

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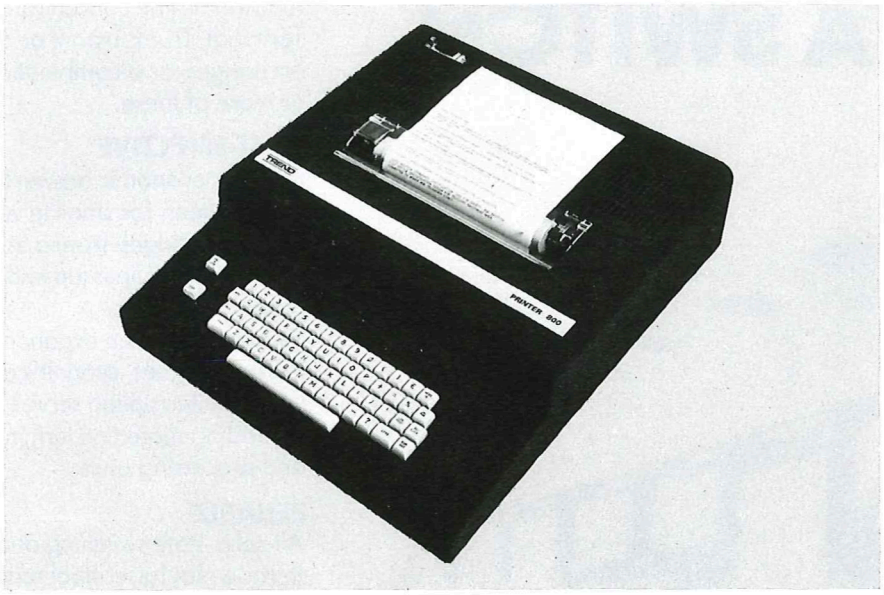

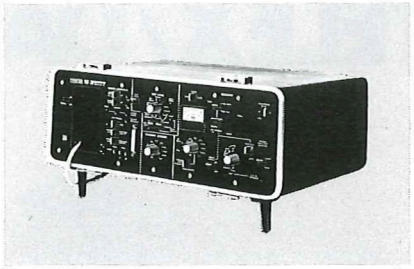

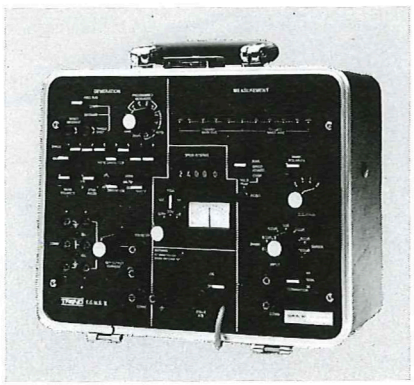

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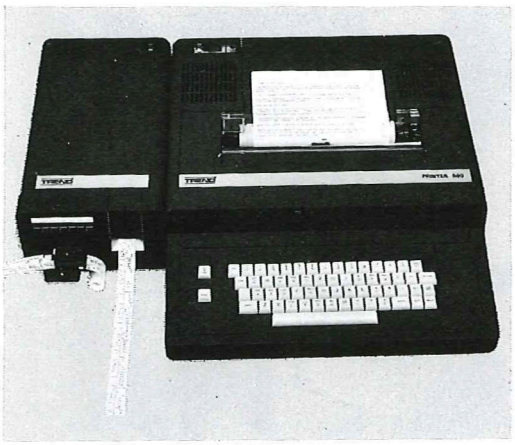

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A year of solid progress

Twelve months of solid progress with many positive achievements – but a few problems as well . . . That was how Post Office Chairman, Sir William Barlow, described 1978/79 during which for the third year running the Corporation's three businesses met the Government's financial targets. Overall there was a total profit of £375.1 million – an increase of £7.4 million over the previous 12 months – to which Telecommunications contributed £347.1 million in a year of record growth.

Telecommunications had seen many important developments. One of the most significant was the continuing advance of System X, the new generation of electronic exchange switching equipment which will have its first major public demonstration in Geneva in September (see p. 16).

Other highlights included installation of the one thousandth electronic exchange, further additions to Britain's international direct dialling system so that 91 per cent of UK exchange lines can call about 87 per cent of the world's telephones in 85 countries, a telephone stamp scheme to help customers save for their bills, a new earth satellite station commissioned at Madley and the Telegram Service revitalised by a new executive.

New products and services planned or supplied included Prestel, the Post Office viewdata service which links television and telephone line to provide pushbutton information on the screen, and a special range of telephones to give customers a wider choice.

Important advances had also been made in the field of optical fibre transmission and transhorizon radio, the Post Office's telecommunications system for isolated oil platforms in the North Sea, was extended to three more platforms. Equally satisfying was the agreement reached with other European countries for the provision of a European Communications Satellite system in which the Post Office has a major financial share and the advanced negotiations for a new transatlantic cable (TAT 7).

For customers there were positive measures to provide them with more information about quality of service and throughout the year the Post Office had worked closely with the Post Office Users' National Council and the Office of Fair Trading to produce a Code of Practice for the Business.

Despite industrial problems and unusually severe weather the number of telephones in use had risen to more than 25 million and $16\frac{1}{4}$ million lines had been connected. Orders for exchange line service were at a record level of more than three million. During the year customers made 10.3 per cent more local, 11.8 per cent more trunk, and 20 per cent more international calls.

And finally, on the topical note of energy conservation no less than £14.2 million had been saved by Telecommunications – making a total of £45.4 million since the fuel crisis of 1974/75.

As Sir William Barlow said: "A year of solid progress . . ."

Post Office telecommunications journal

Summer 1979 Vol 31 No 2

Published by the Post Office of the United Kingdom to promote and extend knowledge of the operation and management of telecommunications

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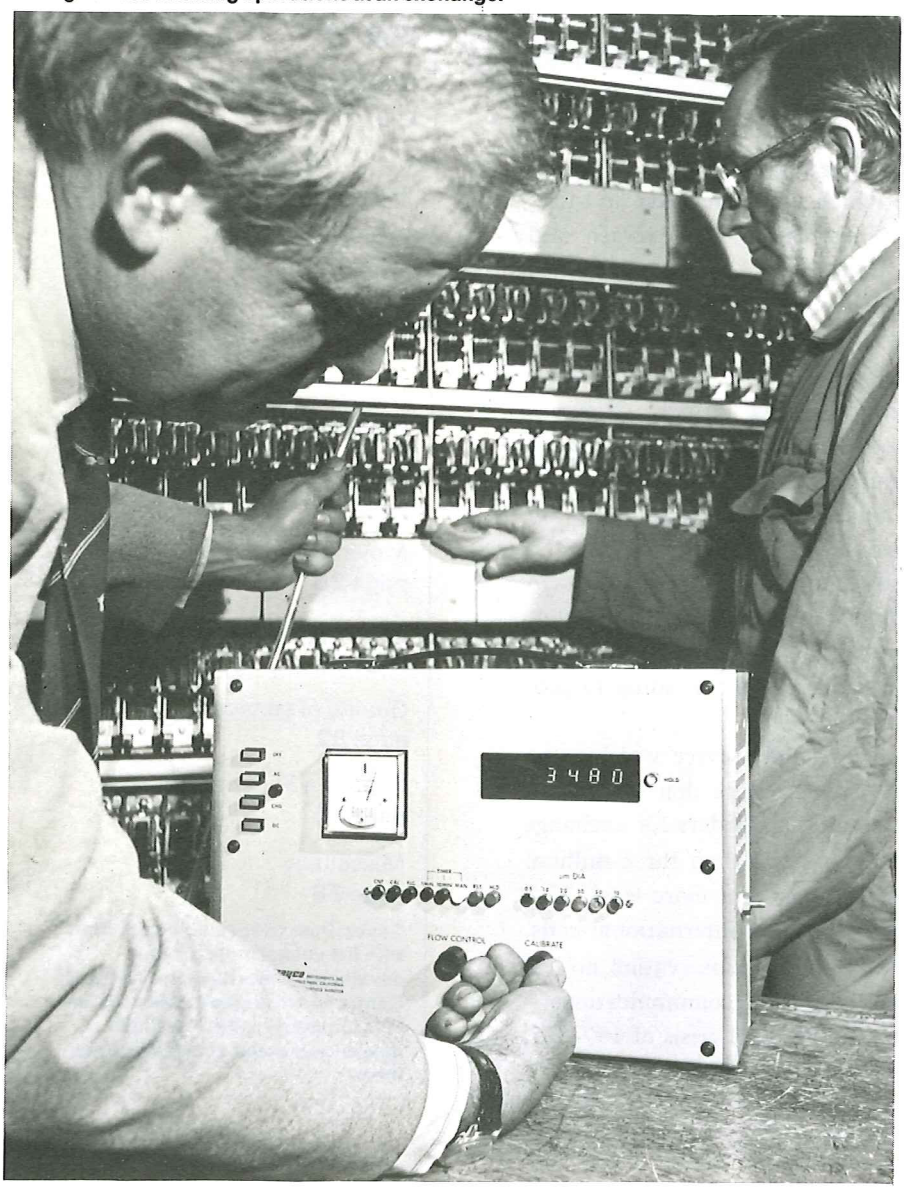
Cover: Post Office cableship 'Alert' with the cut and hold grapnel developed at Martlesham Research Centre which engages, secures and cuts undersea cable in a single operation instead of the traditional three.

Keeping it clean

L H Child

The need to keep telephone exchange switching equipment as free as possible from the effects of dust and dirt is a vital element in maintaining an efficient service. Modern measuring aids to help achieve the increasingly high standards of cleanliness now required are playing an important role in this field.

The author (left) uses a portable monitoring machine to check levels of dirt disturbance during normal cleaning operations at an exchange.



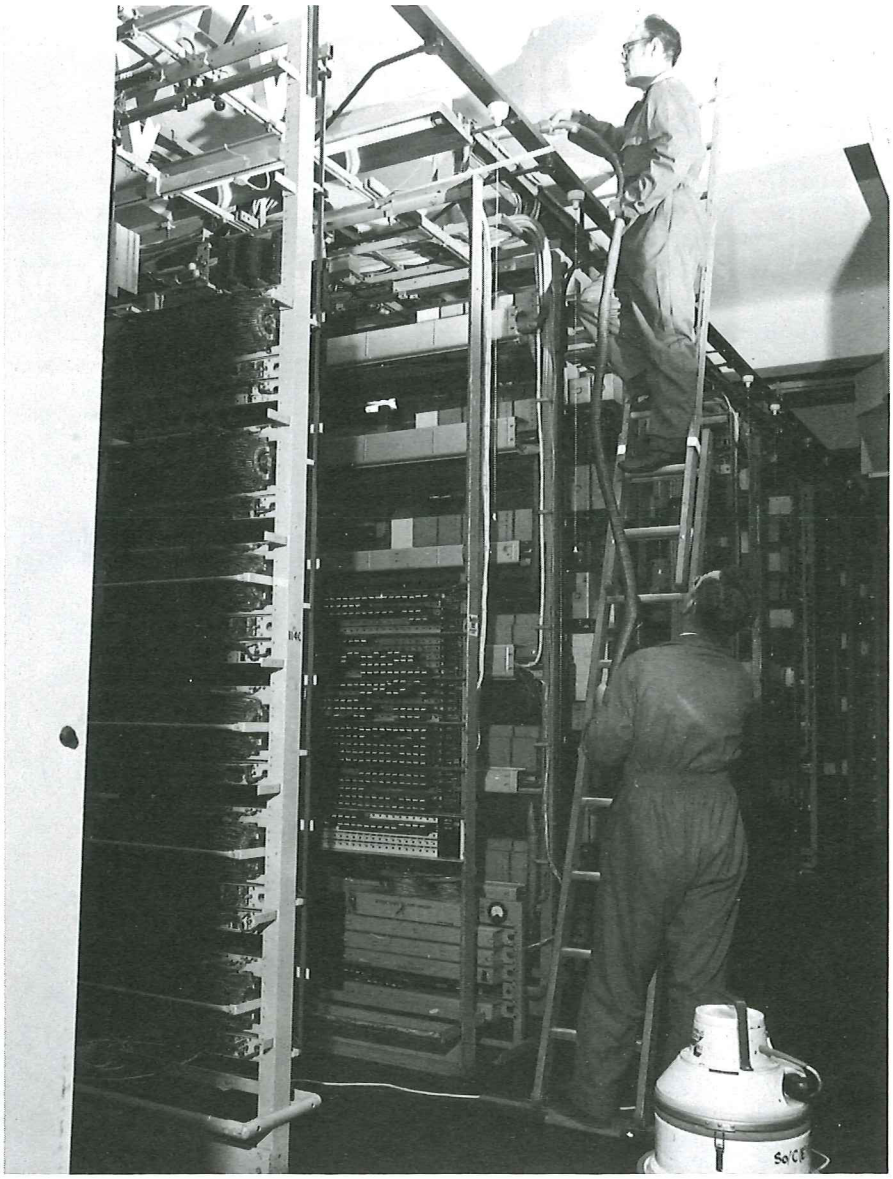
FOR MOST people, the sight of a bright, shiny room, the smell of polish and wide carpet sweeper swathes across the carpet pile, would surely affirm a well-cleaned room. But how clean is clean? Visual assessment is probably fine for a teenager's bedroom but when it comes to food-preparation areas, telephone exchanges, computer halls, operating theatres and the like, normal spit and polish cleaning methods do nothing towards preparing premises for their designated work.

The grime and pollution of day-to-day living is simply scattered around by the mop and bucket brigade, however well-meaning. Because of this more efficient methods, not only of cleaning but of detecting dirt, have to be devised, if delicate and expensive equipment is not to suffer permanent damage. Or still more important – if physical life and limb is to be kept safe from microbes and other noxious materials (see Telecommunications Journal, Autumn 1975).

In 45 years of operation, Strowger exchange equipment has often suffered from dirt fault situations which have been rectified by increasing levels of maintenance and equipment cleaning. As technological development progressively introduces more advanced machinery, so standards of cleanliness have had to be upgraded. Without identifying the dirt problem by size and quantity, it is not possible, with any accuracy, to determine filter standards or cleaning frequencies and methods. And guessing can be very expensive.

Dust particles are measured in two ways – by concentration in particles per cubic foot and by size in microns – one millionth of a metre. Early methods of estimating and measuring pollution levels were limited but included the "test card method" which involved placing a clean card in a room for a period of days or weeks to see how long it took to become dirty, and the "test wipe method" which used a white cloth to dust a surface and see the amount of dirt present.

Later there was the much more scientific approach of "disc filters" used in conjunction with a known volume of air. The filter method allowed a reasonably accurate particle count, down to five microns in size, by means of a microscope and visual grid as the unassisted human eye can only detect particles between 50 and 100 microns. It also allowed the mass of pollution to be weighed. Although laboriously slow and expensive, this is



A mobile cleaning team at work on overhead cable runways at a South London exchange.

still the only accepted method for determining health standards for asbestos or similar pollutants.

More recently modern technology has produced a range of measuring instruments, which fall into one of two fields – measurement by mass within limited ranges of particle size, or measurement of volume of pollution and distribution in selected particle size.

The mass monitor uses a matched pair of crystal oscillators, one housed in a clean air chamber and the other in a measured airflow with large electrostatic charge – 7KV – to attract pollutants to its surface. During monitoring the pollutants settling on the second crystal oscillator, alter its mass and consequently its frequency.

The difference in frequencies of the two oscillators is then compared and read off as microgrammes of pollution per cubic foot of air monitored. Test periods normally last for one minute and particle sizes are set at two measures, up to seven microns and above. Since this instrument only determines mass its use is normally confined to monitoring known pollutants or establishing safe levels of toxic substances.

The Particulate Particle Monitor measures the volume and distribution of pollution in circulation. Recent development has produced a portable model which allows a considerable amount of field work in the measurement of pollution and identification of airflow in telephone buildings. The Monitor measures particle sizes of 0.5, 1.0, 2.0, 3.0, 5.0, 10.0 microns and above counting individual particles on a visual display.

It works on a light scatter principle, which means that when a particle of dirt is placed in a parallel light source the beam of light is deflected. In this case the deflection strikes a photo-electrical impulse which can be amplified and counted. The larger the particle the larger the deflection of the light source.

Measurements of pollution taken in telephone exchanges produced startling results. They showed that the inside of the building could be many times dirtier than outside – and that included all the nicely polished floors and well-dusted surfaces!

Ironically, cleaning methods were shown to be the most pollution-spreading operation carried out in the building. Far from recovering dirt they scattered it far and wide. Many ventilation filters are not effective at three and five microns and the worst fail at 10 microns and below. And it is a fact that traffic pollutants exist in their greatest volume between one and three microns.

The Monitor can also show the flow and source of air in a building. Air at different temperatures does not mix easily and dirt particles of 0.5 to 3.0 microns stay within the airflow in which they were generated. By graphically illustrating the volume distribution of particles within these sizes an individual shape called an airprint is produced which will be retained when diluted. Airprints are currently used in major telecommunications buildings to determine airflow patterns and refrigeration and filtration efficiency. They are used in customers' premises to determine and control locally generated pollutants which affect the performance of PABX equipment.

In the London Telecommunications Region the present target is to ensure that inside dirt levels are no greater than those outside and that where ventilation plant exists filtration standards are improved. South Eastern Telecommunications Region are pursuing similar aims, having already bought a Monitor for their own use, and it is to be hoped that other Regions will follow the same course as soon as possible.

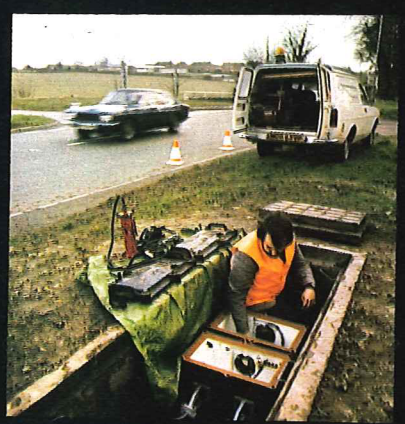
In the short term, electronic units should not be affected by pollutants but with a growing deposit of semiconductive pollutants over a long period no-one can be sure what could happen. One thing is certain: if large scale breakdowns do occur, remedying the situation will demand capital renewal – which in the long run will be more expensive than increased maintenance costs now.

Mr L. H. Child is technical cleaning liaison officer attached to the Service Group at London Telecommunications Region Headquarters.

Optical fibres on order

The Post Office has taken the major step of ordering what is believed to be the most comprehensive network of optical fibre transmission systems yet attempted anywhere in the world. They will form an integral part of the evolving digital transmission network and are not trial but fully operational systems.

RD Martin-Royle



A repeater case is prepared during installation of the STC optical fibre transmission system between Stevenage and Hitchin which used Post Office duct routes.

The process of drawing glass rod into fibres is monitored at Research Department, Martlesham.

IT WAS in the mid-1960s that the possibility of optical fibre telecommunications began to be seriously studied in the United Kingdom. Post Office Research Department and the Signals Research and Development Establishment of the (then) Ministry of Technology concluded that transmission systems using glass fibres to transmit short pulses of light with little distortion and attenuation over very long lengths were a feasible proposition.

It is generally agreed that the major breakthrough came in 1966 with a paper published by two research workers at Standard Telecommunications Laboratories Limited which dealt with the propagation of light signals along glass fibres. At this stage many decisions had to be based on theoretical predictions. It had to be presumed that the chemical purity of glass could be improved by a factor of about one thousand times over that of the best generally available for optical glasses at the time and that glass compositions could be chosen so that the physical perfection of the glasses in fibre would be equal to that of the best bulk glasses. It also had to be presumed that suitable devices such as solid state lasers, light emitting diodes and optical detecting devices could be developed and that fibre termination and jointing techniques could be achieved.

From these starting points when transmission losses in optical fibres were around the 2,000dB per kilometre region, calculations indicated that losses must be reduced to nearer 20dB per kilometre if transmission systems were to be viable. By 1970 this attenuation target was achieved and from then on the quest for lower attentuation fibres accelerated.

Optical fibres have a core of glass of one refractive index with a cladding of a lower refractive index. It is the reflection of light at the junction between core and cladding which contains the light within the fibre and guides it along the transmission path.

Basically there are three types of fibre. The first has a very small diameter core and is known as step index monomode fibre in that it transmits only a single mode. There is an abrupt refractive index change between core and cladding and it has potentially the lowest losses and widest band width properties but is at present difficult to joint.

Step index multimode fibre has a much larger core which overcomes the jointing problems but it allows many modes to propagate usually with different time delays causing distortion of the light pulses. Graded index multimode fibre overcomes the problem of different transmission delays for each mode.

In graded index fibre the refractive index is at a maximum at the core centre and gradually reduces with increasing radial distance from the core centre. Rays which travel along the centre of the core travel the shortest distance but at a lower speed than those offcentre which, of course, have a longer journey. In this way the propagation delay for the various rays or modes is effectively equalised.

Two basic material systems have emerged for forming fibres. The first involves low melting temperature glasses such as the sodium calcium silicates (closely akin to window glass but ultrapure) and the sodium borosilicates (of which Pyrex is one well known composition). The second distinct group includes pure silica (the glass form of quartz). Often the silica is 'doped' with various chemicals in complicated ways to give variations of refractive index across the core diameter. A variety of techniques have been developed for forming the bulk glass and for drawing the fibres.

The fibres themselves are about the thickness of a human hair and even when they are given a protective coating and formed into cables the resultant structure is significantly smaller and lighter than comparable cables using metallic conductors. This represents one of the major attractions of optical fibre systems because more efficient use can be made of the underground duct network. Another attraction with optical fibre is that the raw materials from which it is made are abundantly distributed over the earth and it is likely that when in mass production optical fibre cables will be cheaper than metallic cables.

In their simplest form, optical fibre systems operate by electrical signals such as telephone calls being converted into pulses of light using, for instance, a solid state laser at the transmitting end. This light is launched into the end of a long fibre and zig-zags its way along the fibre which acts as an optical waveguide.

At the receiving end another device (a photo electric diode) converts the light back into an electrical signal which is then amplified and processed to form the original information. The distance between transmitter and receiver depends on fibre characteristics, transmission rate and optical devices and, with currently available

Technician Fred Walker and Louisa Hareduke a CA in the library at Martlesham show the difference in bulk between 500 metres of coaxial cable and the same length of optical fibre cable. Both can carry 16,000 telephone circuits but the coaxial cable on the drum weighs five tons while the optical fibre cable tips the scales at a mere 25lbs.

fibres is, typically about 11 kms at 8 Mbit/s and 8 km at 140 Mbit/s. This compares with a regenerator spacing of about 3.5 km at 8 Mbit/s on carrier cable and two km at 140 Mbit/s on coaxial cables. Longer optical fibre links can simply be made by having a number of sections connected in tandem, the receiver and transmitter back to back forming an intermediate regenerator. Another advantage, therefore, is that regenerators will be needed far less frequently than is currently the case on metallic conductor cable systems. This will mean optical fibre systems give better performance and should have greater reliability because there will simply be less equipment in the transmission chain to go wrong. Further, optical fibre systems are immune from electrical interference which will give major operational advantages.

In 1974/75 Research Department decided to establish trial systems between Martlesham, Kesgrave and Ipswich, operating at 8 Mbit/s and 140 Mbit/s. About the same time Standard Telephones and Cables Limited requested Post Office agreement to establish a 9 km route to operate at 140 Mbit/s between Hitchin and Stevenage in Hertfordshire. These trials were highly successful and the experience gained convinced the Post Office that optical fibre transmission systems were a practical proposition.

How then should this step be taken? During 1977/78 discussions were held between the Post Office and Industry as a result of which it was decided that the next step should be for Industry to be given the opportunity of providing a significant network of optical fibre systems operating at 8, 34 and 140 Mbit/s for operational use in the network. The systems were intended to be essentially proprietary ones acceptable for the UK network and for overseas.

This latter point is extremely important for there is a greater willingness today than ever before to collaborate with industry to obtain the earliest possible benefits from advances in technology and in turn, to help Britain win export orders for its telecommunications equipment.

Organisation of the contracts to provide the proprietary network was also the subject of careful consideration. With traditional metallic cables and transmission systems cable and equipment are provided independently to detailed design and performance specifications prepared by the Post Office. At this stage in the evolution of optical fibre systems it was felt that more experience would be gained if design freedom was given to the suppliers so that they could optimise cable and equipment performance to suit their particular design approaches.

Accordingly it was decided that any contracts let would be "turnkey" with each contractor responsible for the design and provision of all aspects of the system. Prime contractors would be three major suppliers, GEC, STC and Plessey who in turn could choose their own cable sub-contractors.

The network chosen has been deliberately designed to provide a variety of conditions under which the cables and systems must operate.

The intention is to have the first system installed and completed ready for service by September 1980 and for the remaining systems to be provided during the period ending December 1982.

Because the Post Office was anxious to allow maximum freedom for innovative design it has limited its specification to minimum requirements.

The map below shows the proposed network. 8 Mbit/s systems are predominantly on routes in the junction network since it is in this area that lower capacity systems are of particular interest.

The choice of 34 Mbit/s is particularly interesting. This is a transmission speed which the Post Office has currently no direct plans to use in the network. Nevertheless, there is growing international interest in it as it is a natural stage in the digital hierarchy 2-8-34-140 Mbit/s and as such offers British Industry the opportunity to demonstrate equipment having a significant export potential.

The proposed network of optical fibre routes.

The 140 Mbit/s and 34 Mbit/s routes will require intermediate regenerators and although most of these will be buried some will be installed in buildings adjacent to the routes. The longer 8 Mbit/s routes will also require intermediate regenerators, which will be provided in the same way, but they will not be required on the shorter 8 Mbit/s routes.

The routes in Wales, all 8 Mbit/s, are of particular interest as they will have sections of cable suspended on poles, and on one of the routes there will also be a 1.7 km section laid on the bed of a lake. The other routes in the network use normal duct provision in a variety of country and town environments and in London some of the cable will be in the deep level tunnels.

All the cables will contain eight fibres of the graded index variety. Where buried regenerators are required copper conductors will be used to carry the essential power feeding current and supervisory signals to the repeaters. The total length of optical fibre cable to be provided is around 450 km giving a fibre requirement of 3,600 km in total which is more than enough to stretch from Land's End to John O'Groat's and back again.

Each route will be equipped with two systems of the appropriate transmission rate the only exception being two of the routes in Wales where for networking reasons it is necessary to equip them with four systems. Each system will require two fibres, one for each direction of transmission.

By carefully monitoring the design, production and installation phases the Post Office will gain much information on possible system configurations: data which would be very time consuming to accumulate by other means.

As a further display of the confidence surrounding such systems the provisioning is being carried out by normal works procedures with the full involvement of Regional and Area staff to oversee the installation and commissioning of what must be regarded as one of the most dramatic steps taken in telecommunications.

Mr R. D. Martin-Royle is Head of Line and Radio Works Division of the Transmission Department THQ Network Executive.

Use of Prestel, the Post Office's viewdata service is aimed at the home as well as the Business market.

At home with the phone

Following his article in the last issue of the Journal on the wide range of new telecommunications products and services being offered to the business sector, **Mr F. Lawson,** Director, Residential and Customer Services, Telecommunications Marketing Executive, now turns to similar developments being made for residential customers.

PRESENT DEMAND for telephones in the residential market is at a record level. This is due to a number of factors – stability of tariffs, improved marketing techniques and a growing recognition of the value of the telephone in everyday life by all sectors of the population.

Today about two out of every three households in the UK have a telephone and in some Regions, the figure is much higher. The intention is that residential penetration should reach over 80 per cent in the next few years and then climb quickly to the high nineties. Even this figure has been reached and exceeded in some countries and there is no reason why 100 per cent should represent an absolute limit – for example, a second exchange line, perhaps fitted with a simplified coin box might be the ideal answer for the children's next birthday gift.

There is already a wide range of telephones from which customers can choose and it is planned to increase the choice available each year. An im-

portant recent development has been the growth of push-button calling. Almost 400,000 push-button telephones of various types are already rented, including push-button versions of the standard telephone, wallphone, trimphone and loudspeaking telephone. With the progressive introduction of MF signalling full push-button calling (known as "Touch Tone" in the USA) will also eventually become available.

The existing range of home telephones will be further extended by the introduction of the "Compact" model, so named because it is much reduced in size by removal of the bell-set to a separate unit. This enables the telephone to be sited on narrow shelves or window ledges, or on its own custom-built shelf unit available on request.

Current customer choice has recently been widened considerably with the arrival of the new "Special Range Telephones". Considerable evidence has been uncovered, showing a sizeable market for "fashion" telephones. Initially there are seven models in this range, but it will be extended progressively as fashions change.

It is hoped that this wider range will encourage people to regard their telephones as an essential part of the décor of their homes adapting it to higher standards of living and changing fashions. The hope is also to encourage customers to have more than one telephone in their home – the UK stands very low in international tables of residential extensions and the telephone to exchange line connection ratio shows there is much scope for growth.

At present there is no need to stimulate the market generally but during the last few years the Telecommunications Business has learned how to do so. It has been proved that the market can respond to "supermarket-style" special offers like reductions in the connection charge over a limited period.

And much can be achieved by better publicity of available services. Improvements have been made to the "Green Pages" in telephone directories emphasising the range of products and services. Inserts have been included with telephone accounts to advertise new products and also with success in mail-order catalogues.

A prototype telephone showroom has opened in Swindon and introduction of a number of telephone shops around the country is also planned. These will help to brighten the Telecommunications corporate identity and bring about a closer personal relationship with customers while giving a new and dynamic channel for marketing products and services in the residential and small business sectors.

In addition shops will open up the opportunity to stimulate revenue by providing a prominent platform for national or local marketing campaigns, helping particularly with the promotion of premium products such as the "Special Range Telephones". There is no doubt that an established presence in the local High Street will be of great value in helping the Business to meet future challenges.

But telecommunications in the home embrace more than simple telephone connections. Prestel is aimed at both business and the home. In the latter it can promote use of the phone and perhaps lead to the renting of additional lines. And increasingly parts of the residential market have shown a willingness to rent types of ancillary equipment which might in the past have been regarded as exclusively business products.

Callmakers are an example and products such as the Xpress Callmaker, with its ten-number store, are expected to find favour among residential users. The Doric loudspeaking system, scheduled for national availability later this year, has already proved in a market trial that it is useful in the home and enables the whole family to listen to grandma's weekly call or even Dial-a-Disc! In the same way, answering and answering/recording equipment will become more popular with residential customers: a large market could exist, for example, for a low priced answering machine for home use.

Radiopaging and Facsimile could also well find a role in the home. For some houses, Alarms-by-Carrier might provide improved protection. And as we rely more and more on gadgets in the home, telecommunications signals could perform a variety of tasks like switching on the central heating or the cooker. Looking farther ahead telecommunications could even help remove the present distinction between "home" and "office" by enabling more business executives to work at, and from, home – a blessing for harrassed commuters!

But marketing is more than just providing products and services. It also involves increasing their value to customers and giving those customers a good "after-sales" service. As for call stimulation the success of Buzby continues unchecked. In this year's television advertisements, a new-look Buzby is joined by a number of new characters and his popularity is shown by the enormous success of Buzby merchandising with a very large and still-growing range of products now available in the shops.

Further call-stimulation should result from current publicity encouraging wider use of Recorded Information Services, both using national media to publicise individual services and also using account inserts carrying commerical advertising, to be distributed with telephone bills. This year's leaflet features particularly the speaking clock, weather and recipe service and bedtime stories. Plans are in hand to extend the range of recorded services available.

As the availability of International Direct Dialling (IDD) continues to spread, it obviously opens a new area for increasing traffic. Almost 90 per cent of all telephone subscribers can now dial international calls direct from their homes, with access to over 80 countries. Yet, although it is estimated that whereas more than half of all UK residents have friends or relatives living outside Great Britain, only a relatively small number have made an international call in the last six months. A series of television advertisements this year will help to promote the value-for-money aspect of international calls.

Marketing to the residential sector will need to change in the next few years. The plan is to segment the residential market in the same way as the business market. It is necessary to consider the telephone usage characteristics of the executive, the housewife, the teenager – who has grown up to regard the telephone as an essential part of social and school life – and eventually that current little group of 30,000 Buzby Club members.

Thought must also be given to the special needs of the handicapped and of elderly people for whom the telephone represents a lifeline. Many years ago in North America, the telephone was called "This great contrivance". In the modern home it has a bright future and it is the role of marketing to ensure that all expectations are fulfilled.

Mr F. Lawson has over the last few years been greatly involved in new marketing approaches and the development of new products and services. He is also concerned with European harmonisation of services and facilities.

PO Telecommunications Journal, Summer 1979

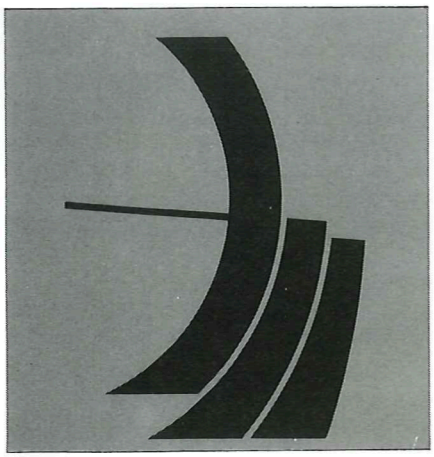
Top: The pushbutton wallphone – convenient and attractive anywhere in the home.

Above, left: The Compact – a new, smaller telephone which fits on a narrow shelf or window ledge.

Above, right: The Candlestick – latest version of an old style instrument with modern components.

Right: The Classic – a modern variation of an antique style telephone.

Far right: The Astrofon – a lightweight pushbutton phone with an adjustable bell.



The WARC 79 logo.

Radio's future pattern

JR Mackie

The UK proposals to be presented at WARC 79 together with some of the extensive range of present regulations which will be under discussion.

POST OFFICE staff both from Telecommunications Headquarters and the External Telecommunications Executive will be playing an important role in the next World Administrative Radio Conference (WARC 79) opening in September at Geneva.

With about 150 member countries expected to attend, the 10 week conference will, for the first time in 20 years, revise those parts of Radio Regulations applicable to all radio services, and in particular the whole of the international frequency allocation table. It will take into account worldwide demand for radio services and current and foreseeable means of making better use of the radio frequency spectrum. And its conclusions will decide the future pattern of development of radio services and equipment up to the end of this century.

The International Telecommunication Union (ITU) International Consultative Committee on Radio (CCIR), held a special preparatory meeting last October, to prepare a report for WARC 79 setting out the technical basis for the work of the Conference. The report drew on the work of the CCIR but also included some important additional information provided by contributors including the UK. This covered topics of concern to all radio services and CCIR provided technical advice on the allocation of frequencies throughout the spectrum and on the possibilities of frequency-sharing between different services. A separate section dealt with the use of the spectrum by space services, including space-terrestrial sharing.

The report also looked to the future with recommendations on frequency bands at present unallocated or unused, and on frequency allocations for new services. There were sections on optimising the use of the frequency spectrum; on the technical characteristics of equipment and emissions; and on radio wave propagation and noise data relevant to frequency and control.

The Post Office was closely associated with these preparatory activities through its co-ordinating unit, the Post Office Committee on Administrative Radio Conferences (POCARC), and a subcommittee chaired by Mr D. J. Withers, Deputy Director, Space Systems, Telecommunications Development Department. was charged with drawing up official contributions to the work of the Conference.

Membership of this committee was drawn from THQ and ETE staff concerned with the planning, development and operation of radio services. Members have previously sat on a number of Home Office committees set up during the last four years to determine among other things the needs of radio users in the UK over the next two decades; resolve differences between competing claims for spectrum; formulate UK proposals for the re-division of the frequency spectrum based on competent technical advice and for the revision of operational and administrative regulatory procedures.

They are now co-ordinating the briefing of the UK WARC 79 delegation, to which the Post Office will be contributing a number of members. Obviously, the importance of such a wide ranging reappraisal is of worldwide telecommunications significance. The outcome will be featured in a future issue of Telecommunications Journal.

Mr J. R. Mackie is Head of the Radio Frequency Spectrum Administration Section in Telecommunications Development Department's Space Communications Systems Division.

PO Telecommunications Journal, Summer 1979.

Bits everywhere as network grows

G T Pritchard

Two new transmission systems, the first members of a compatible family which will form the digital transmission infrastructure for System X, have been brought into service by the Post Office to enable an integrated digital switching and transmission network to be established. They are 2 Mbit/s and 120 Mbit/s digital line sections

TRANSMISSION of information in digital form is not new. The first methods of telecommunication by morse and telegraph were of this type. The essence of this form of transmission is that the information is represented by a series of pulses or binary digits referred to as "bits." The main advantages of digital transmission are that all forms of telecommunication or services can be converted to a common format, interleaved or multiplexed in a time division process. The received signals for each service can then be demultiplexed into the format of the original service.

Coventry Area data transmission 'clerk of works' Dave Salter attends to maintenance of a buried footpath repeater on the Coventry-Northampton digital link. Maintenance jointers Malcolm Boston (left) and Richard Ramsay take a keen interest.

Transmit apparatus of a 120 Mbit/s line transmission system showing the new technique of cassette construction.

Most long distance radio and line transmission currently uses an analogue technique with frequency division multiplexing (FDM). In this process the signal is carried as a replica or analogue of the original although it may be displaced in frequency. This method is satisfactory in a space-switched environment but it demands separate networks for most special services.

The major advantage of time division multiplex (TDM) transmission, however, is that compared with FDM, it is innately compatible with digital switching units such as will be used for System X. These new exchanges will use a time division process so that a group of 30 circuits carried by the 2 Megabit per second (Mbit/s) digital stream can directly interface with the digital exchange and eliminate, at the switching/transmission interface, any need to interconnect at speech frequencies.

The basic building brick of the new digital transmission network is a link which has a digital rate of 2 Mbit/s. This can be used where 30 separate telephone channels are encoded by pulse code modulation, for telegraph circuits with 184 telegraph circuits each operating at 50 baud, or for the wideband music circuits such as broadcasting authorities require when three pairs of stereophonic channels or six separate monophonic channels are combined on to the 2 Mbit/s path. This rate can also be used for data transmission such as inter-computer links, and for customers who wish to rent their own 2 Mbit/s digital path. Some new private exchange systems require this facility to operate satellite exchanges from a main centre.

The 2 Mbit/s stream can be used to build up the next stage of multiplexing or transmitted over a line system. The standard multiplexing hierarchy interleaves several (usually four) tributaries to give higher orders in the hierarchy at 8, 34, and 140 Mbit/s and an even higher order of about 565 Mbit/s may be introduced in the future.

Digital line and radio systems have been developed to fit in with the orders of multiplexing and to use the existing transmission plant economically. The 2 Mbit/s digital line section uses pairs in the vast network of audio cables in the junction network and the regenerators are spaced at the same intervals as the loading coils that have to be displaced for digital operation.

One of the earlier FDM systems used a special 24-pair carrier cable but much of the associated equipment is now reaching the end of its useful life. The 6,000 km of cable route are, however, considered to be good enough to re-use and an 8 Mbit/s system is being developed to give these cables a new lease of life.

The 120 Mbit/s system being introduced this year – and the 140 Mbit/s system which will follow later – use mainly spare tubes in existing coaxial cables although new cables will be laid where necessary. These cables systems are designed to have regenerators spaced at the same distances as for 12 MHz FDM systems which will, in many instances, already be installed on other tubes in the same cable.

The 11 GHz radio band has been reserved for the first digital radio-relay system. On each radio route it will be possible to get 6 × 140 Mbit/s channels although one will be allocated as a standby. The repeater spacing of the 11 GHz system will enable existing radio station buildings to be used. A dual-band aerial is being developed so that in most cases existing structures will not need to be strengthened to support additional aerials.

The future for line transmission systems is considered to lie in the field of optical fibres. This has already reached the stage where both the Post Office and Industry have separately demonstrated satisfactorily that systems at both 8 Mbit/s and 140 Mbit/s can be made and installed. Plans are currently being considered for installation of systems within the next few years.

Although PCM is justified in its own right in many instances, the real pay-off for a digital transmission network stems from the establishment of a network in which the transmission and switching form an integrated digital structure and from which the benefits of inter-connection at other than speech frequencies can be achieved. An example is the System X switching unit which will be capable of a 2 Mbit/s input. This advantage was quantified in the early 1970s as a result of studies by the United Kingdom Trunk Task Force (UKTTF). Subsequent studies have served to confirm this.

While the new digital systems will have many advantages the interim period of having a hybrid analogue and digital environment creates many problems. One way of overcoming some of these is by having special "interface" equipment available to facilitate interworking. Codecs, modems and transmultiplexors all come into this category. Codecs enable analogue services to be carried over digital line plant while modems make analogue line plant available for digital signals. Modems and codecs for a variety of speeds and signals are already available or soon will be. Transmultiplexors will directly convert signals between FDM and TDM. They are an attractive idea but at present are still under study.

Although widespread benefits of a fully integrated transmission and switching system are some years away there are significant advantages to be gained from having digital transmission even in a space-switched environment. All services, for instance, can be carried using a common format and multiplexing hierarchy. It is also a fact that the quality of transmission is better because the digital signal is regenerated at intervals along the line, unlike the analogue system which amplifies both signal and noise accumulated en route. Finally there are economic advantages because the digital transmission technology is shared with other industries such as computers and micro-electronics. This means, in fact, that although TDM is more complex than FDM, it is cheaper.

One method of introducing digital transmission is to provide a digital network as a thin overlay, taking where possible, the growth on the new system. The heaviest growth parts of the trunk transmission network are the industrial Midlands and North and their links to London. It is these areas which are being first served with long distance digital transmission. Firm plans have now been made for several years ahead and the map opposite shows that by 1984 the long distance digital transmission network will extend from Aberdeen to Portsmouth and from Truro and Swansea to Ipswich.

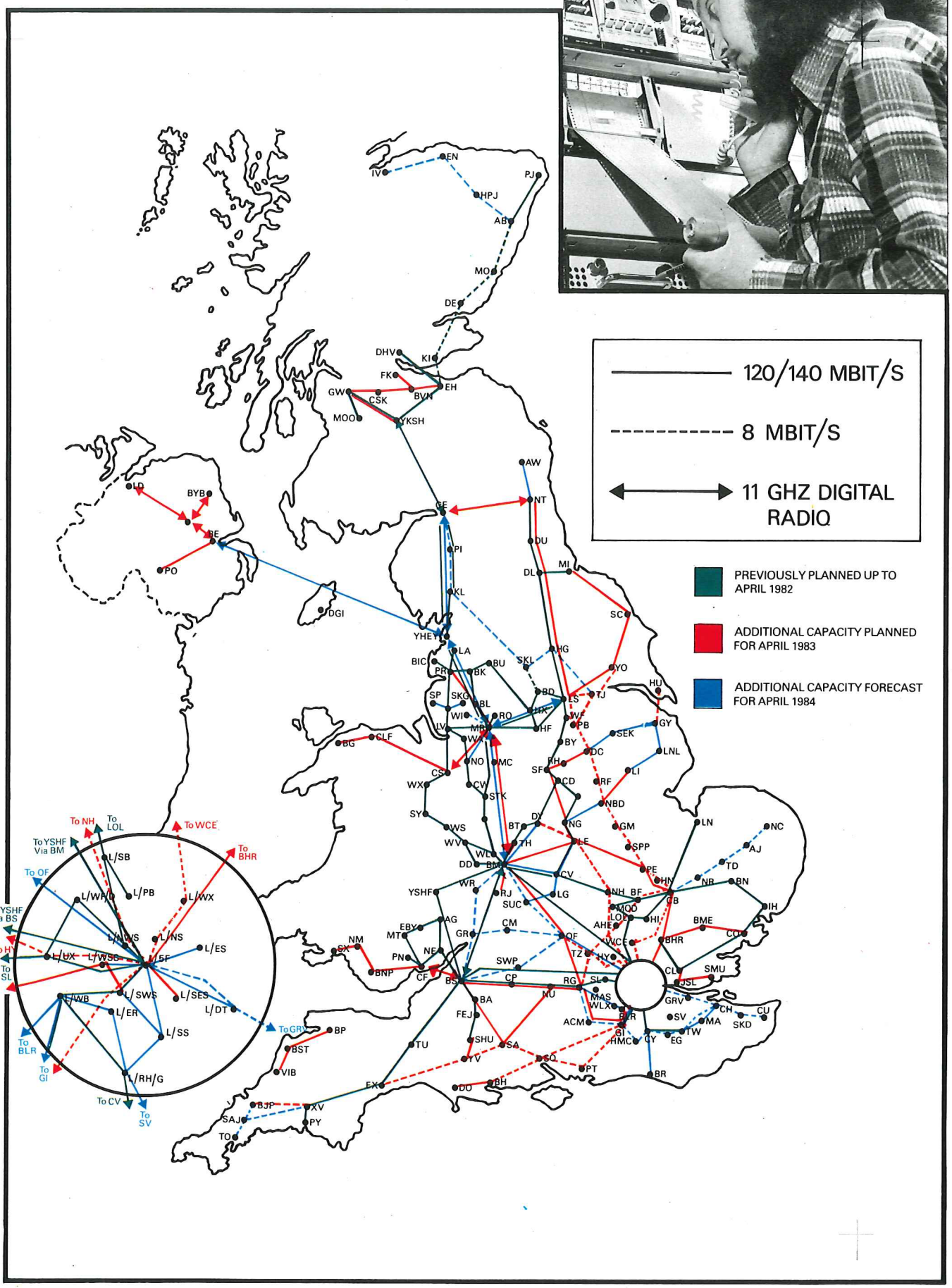
The first three digital main network switching centres at Cambridge, Coventry and Leeds, are all well within this network and plans have been made for all of their main network circuits to use digital transmission. At the end of the next decade almost all growth in main network transmission will be on digital systems and by that time more than one third of the inland network requirement will be carried by digital systems – rising to over 50 per cent before the end of the century.

These plans for digital transmission are based on existing policies which do not include the possibility of an accelerated changeover from analogue systems in support of digital switching, which is currently being studied in conjunction with switching and junction planners. It is an indication of the future need for greater co-operation and co-ordination in planning activities so that total system economies can be achieved throughout the network.

Mr G. T. Pritchard is a Head of Group in the Transmission Department of the THQ Network Executive and is responsible for planning long distance transmission.

Technical Officer Dave Salter makes the daily check of chart recorder rolls on Britain's first commercial digital data transmission line system at Coventry Leofric repeater station.

The digital transmission network as planned earlier this year for installation by 1984.



It's plain sailing by phone

G E Grummitt

MENTION the name Hoseasons and for thousands of holiday makers throughout the United Kingdom, thoughts will immediately turn to cabin cruisers, yachts and longboats, and rivers, broads and canals. Based at Oulton near Lowestoft close to the heart of the Norfolk Broads, the firm is one of the best known in the country for providing water based holidays and has recently invested

John Holmes, a Post Office Technician, checks a fault on one of the key and lamp units used for holiday bookings at Hoseasons.

Scene of great activity during the winter months is the dial-a-brochure room at Hoseasons headquarters where the sophisticated new telecommunications facilities are used to the full.

Left: Norwich Area Technician Jim Tipple runs cable for an outside telephone bell at one of Hoseasons many boatyards on the Norfolk Broads.

in a sophisticated new telecommunications system to cope with the ever growing business of dealing with booking enquiries by telephone.

Although the holiday period itself does not begin in earnest until the summer, the booking season runs from November to March reaching a peak in January. At this time 300 or more temporary staff are called in to help the 40 full-time operators deal with enquiries on 163 exchange lines which are open between 9.00 am and 9.00 pm. Calls made at any other time are switched to a battery of 96 answering and recording machines.

In previous years seasonal telephone equipment was installed as necessary in adjacent temporary accommodation but the move to install a modern new telecommunications system was made when Hoseasons decided to extend their main office building. In November 1977 Post Office staff from Norwich Telephone Area were called in to help plan and equip the new building which was due to be operational within a period of not more than twelve months from the starting time.

One of the main problems from the Post Office's point of view was that the space available for the new offices would be otherwise occupied until March 1978 – thus allowing a maximum of only seven months to complete all the work which was necessary. Also, of course, the existing telephone services within the main building had to be maintained during the expansion period and this meant duplicating many of the established key and lamp units.

In the interest of flexibility and to even out operators loadings, the 163 exchange lines are terminated on 112 key and lamp units 87 of which are 20-way and 25 are 10-way. They are wired so that calls appear at differing positions on the various units. Each unit has two operator circuits.

The four supervisory positions created extra engineering problems because 12 100 wire cables were required at each position. The facilities provided for the senior supervisor, enable him, in fact, to monitor 70 exchange line terminals on 10 key and lamp units which are wired as for one operator's circuit. Throughout the whole premises cabling for the units is fed through chrome tubing suspended from the ceiling to the desks below where staff are busy at work.

When the system was acceptance tested it was found necessary to change each of the 1990 lamps over to 50 volt working to ensure sufficient power to light them. Apart from minor teething troubles, however, the changeover went smoothly and Hoseasons were ready for business when the bookings rush began last November.

By the time it had finished four months later no fewer than 426,577 incoming booking calls had been handled – 80 per cent of them in a five-week period soon after Christmas. On the peak day in January almost 12,000 calls – 1,000 an hour – were dealt with by the team of 120 operators and other staff who are on duty at any one time during this hectic period.

For Hoseasons the new system is undoubtedly a boost for business: for Norwich Area staff there is the satisfaction of having been directly involved with the biggest installation of its kind in the country.

Mr G. E. Grummitt, is a Sales Superintendent in Norwich Telephone Area responsible for territorial sales in the Lowestoft area.

A £1 MILLION campaign launched by the Post Office and major UK manufacturers to demonstrate to the world that Britain is set to recapture its global lead in the fiercely competitive field of telecommunications will culminate in a spectacular joint display at the TELECOM 79 exhibition in Geneva in September.

"The British telecommunications industry is right back in business as far as world markets are concerned," said Sir William Barlow, Chairman of the Post Office, "and this September we shall have a range of new products which will be of interest to other administrations."

Joining the Post Office in the co-ordinated display of products, systems and services are GEC Telecommunications Ltd., Plessey Telecommunications Ltd., Standard Telephone and Cables Ltd., Marconi Communications Systems Ltd., and Pye TMC Ltd.

Highlight of the British exhibit will undoubtedly be a working model of System X, Britain's all electronic digital telephone exchange system for the 1980s and beyond. It will be the first time the equipment has been publicly demonstrated.

"We will be showing how System X can be adapted to the different service and operational needs in Britain and abroad" said Sir William. "It is not just another exchange system – but a complete approach, in which computer aids in design, planning and operations are helping to cut costs and reduce the time taken to respond to new technology."

The largest single telecommunications development project ever undertaken in this country, System X is a collaborative project between the Post Office, GEC, Plessey and STC and the four organisations have formed a new company – British Telecommunications Systems Limited – to promote System X overseas.

Sir William emphasised that the Post Office was dedicated to doing everything it could to help the manufacturers in their System X export efforts. "This approach is right in line with our joint interests" he said, "For the British Post Office to be able to buy at the lowest possible price, our manufacturers need the widest possible overseas markets."

Because of its flexibility, System X meets a wide range of customer needs. It is as suitable for the user wanting a relatively simple network, with few facilities, as for the administration seeking a complex system offering a range of services that can be rapidly expanded and diversified. And it can also take advantage of new technical advances in electronics without basic system redesign.

But TELECOM 79 is also a shop window for much else besides System X. Prominently on view will be a range of modern digital transmission systems and new designs of customer apparatus appropriate to the coming digital era. The display's overall theme is to show how British products and services can meet today's two main challenges of serving the widely different requirements of telecommunication administrations throughout the world, and taking full advantage of continuing advances in relevant technologies, notably microelectronics, software and digital operation.

These advances are opening up new and more effective services, systems and planning and management techniques. To enable this progress to be properly harnessed, the Post Office, jointly with industry, is creating an overall strategy to serve as a framework for the development and introduction of these new systems and services.

This strategy embraces many short term developments in which the new technologies are helping the Post Office to hold down costs and improve customer services. Such developments which will be on show at Geneva, include new measurement and analysis centres (MACS) in which artificial traffic generated by computers detect and locate faults more readily, and automatic call recording equipment (ACRE), shortly to come into service to provide an automatic record of operator calls for billing purposes.

A substantial area of the display is set aside for customers' apparatus and services, and includes new generation telephones developed for the 1980s, and exploiting the advantages of push-button operation. There are Business Interconnection Systems, including a "Small Key System" which provides fast connection for up to six people, Small

Business Systems, now available in four versions from British Industry, catering for up to 40 telephones, call-connect systems, including the Premiere, with wholly pushbutton switchboard console and compact equipment cabinet catering for up to 10 exchange lines and 48 extensions and providing many facilities.

CDSS1, the advanced digital PABX designed by the Post Office and to be known in this country as Monarch 120 will also feature prominently. The system caters for up to 10 exchange lines and 120 extensions, with a double unit – using 240 extensions – an emerging option. Modular software control enables facilities to be tailored to users' individual needs.

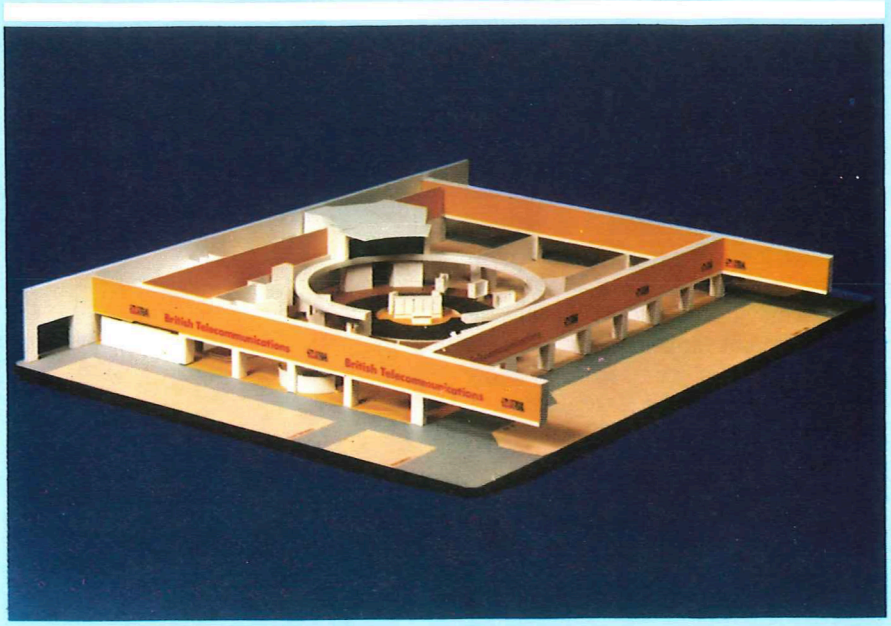
In the co-ordinated display, CDSS1 will be a working model connected to System X demonstrating a wide range of services and facilities. It will also be interworking with new types of customer equipment, notably a digital facsimile terminal operating at 64 kbit/s.

New systems being developed and introduced into the Post Office network, such as PCM multiplex and 2 Mbit/s junction line and multiplex equipment will also be on show as will higher order digital multiplex at 8, 34 and 140 Mbit/s for use with trunk systems for 120, 480 and 1920 telephony channels respectively. Optical fibre systems, whose large scale introduction into the Post Office is now going ahead, following extensive trials in East Anglia and elsewhere, will feature as well.

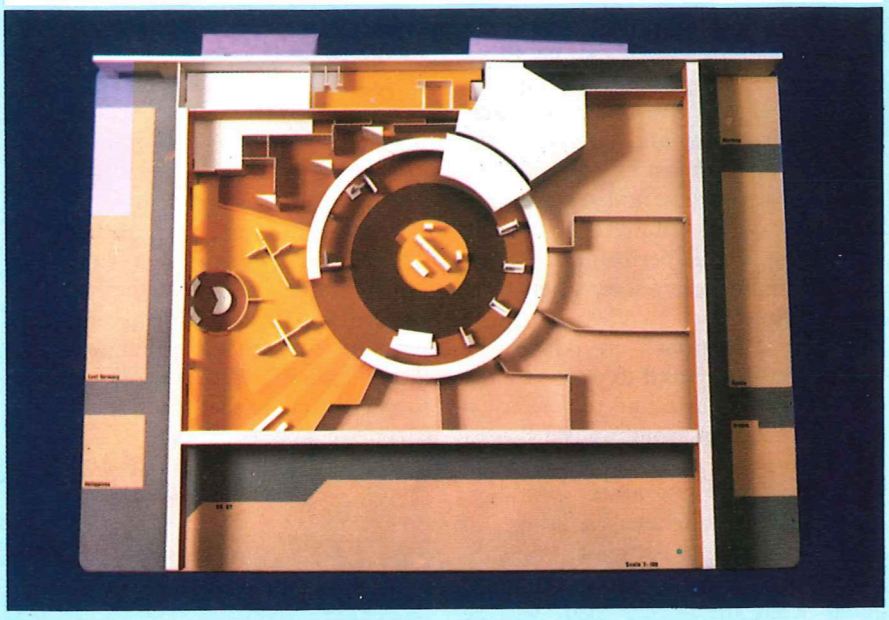
Exemplifying the wide range of new customer services that can be provided, even by today's network, will be a demonstration of Prestel, the Post Office's world-leading viewdata information retrieval service.

Other customer services on show in Geneva will include Alarms By Carrier, a cost-cutting system using a subscriber's ordinary exchange line to summon help from the emergency services; Radiopaging, a way of contacting people out and about away from their office or home; data transmission, demonstrating the leading position Britain has maintained in this activity since its earliest days; facsimile, a way of sending replicas of documents by phone; conferencing services, using both audio-visual and audio-only systems, enabling people in different locations to meet and talk together as if in the same room and telegraph services, using a range of modern teleprinter machines.

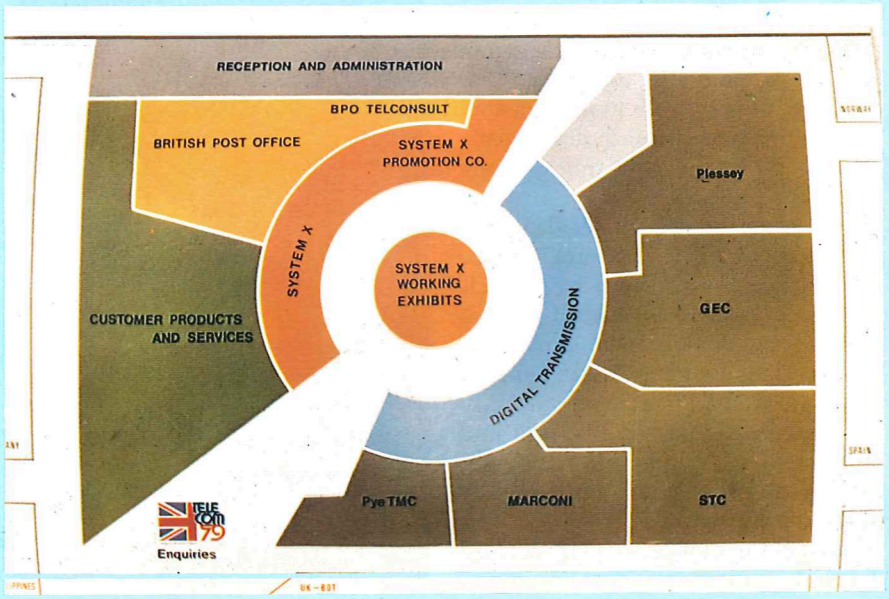
Certainly visitors to the British Pavilion will have much to catch and hold their attention.



A model of the British Telecommunications stand at Geneva



Above: An aerial view of the model and below, the areas taken by the Post Office and the other companies.



Reliability– the key factor

R Millard

ONE OF THE cornerstones of the successful operation of Post Office Telecommunications is reliability of the great variety of equipment which it uses. For not only does reliable equipment – whether it be a telephone handset, a length of cable or an item of switching equipment – enhance the service itself, but it also saves millions of pounds a year on maintenance costs and lost revenue.

But achieving reliability is not as easy as might appear and requires painstaking effort from many quarters. Perhaps first it would be useful to define reliability. The internationally accepted definition is "the ability of an item to perform a required function under stated conditions for a stated period of time". Analysis of this becomes an interesting study in itself and one that is also essential if there is to be any hope of obtaining reliable equipment from design or manufacturing contracts.

Detailed knowledge must be available of what the item's "required function" is intended to be to be able to define it clearly and directly in the specifications. It must be possible to be able to place values, and tolerances if necessary, on all requirements and be able to say that if performance strays outside these tolerances, then that item has failed.

"Stated conditions" in which the equipment is required to operate must also be known including the electrical (and mechanical) conditions imposed on it as well as such environmental parameters as temperature, humidity, dust or electromagnetic radiation. In some cases, such as equipment on subscribers' premises, little may be known about what the environment will be like but this does not remove the responsibility; it just makes the job more difficult. Finally, it must be known how long the equipment is intended to last. It is pointless expecting poor equipment to last for a long time, and, conversely, nonsensical to design for a 20-year life if the item will be obsolete after a few years.

Even when it has been decided what is wanted, there is still much to be taken into account. There are, in fact, four main areas to consider if the end product is to provide reliable service – specification, design and development, production and installation and use. All must be considered in detail and often present conflicting demands, making a well documented reliability programme essential.

Personnel specialists may be involved if novel maintenance methods are to be used. Almost certainly, Development, Service, Research and Quality Assurance disciplines will be commonly involved. A programme can be very lengthy and detailed in the case of a large project or a complex system or quite brief for a single item.

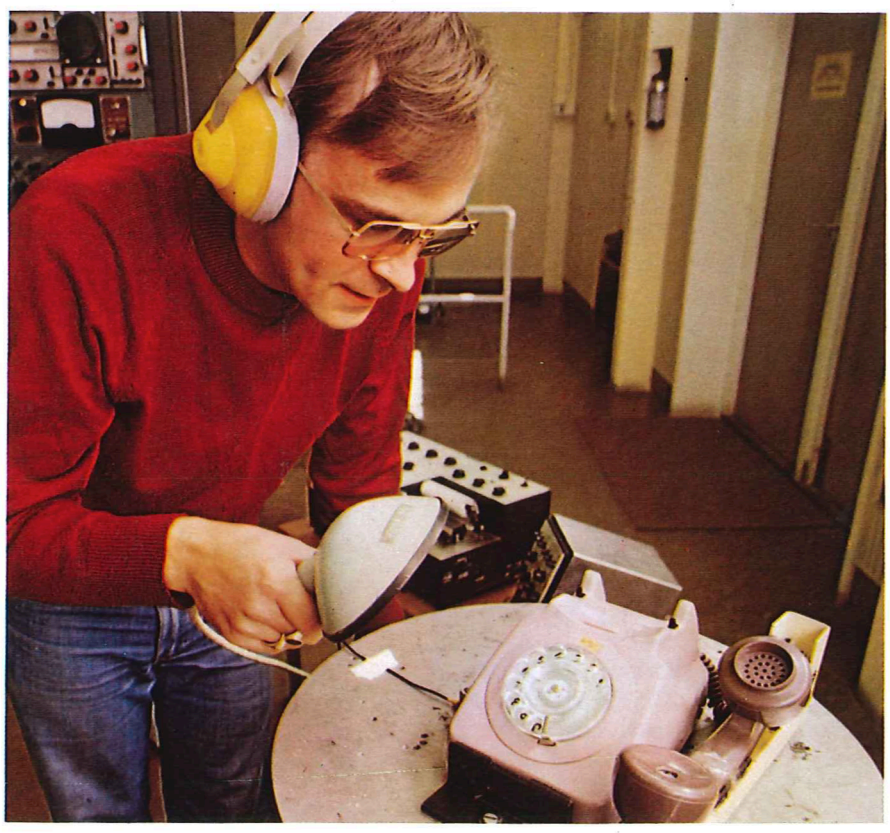
Take specification for example. It is very important that any specification should be clear and unambiguous. If it is not, the manufacturer may not know exactly what requirements the item is expected to fulfil and so will not be able to make it satisfactorily.

Design and development is possibly the most important stage in the life of any product. Poor design can easily lead to difficulties throughout manufacture and trouble during use. The purpose behind all reliability programmes, and design control measures in particular, is to reduce the overall life cost of the equipment. To this end, and to reduce problems in manufacturing and use, proper design control measures are essential. These disciplines are applicable to everyone concerned with the design, but particularly to the design organisation itself. This organisation is in most instances,

Below: Technical Officer Ian Deverell uses a strobe to study any movement of the dial mounting on a telephone undergoing testing on a vibrating table.

Above, right: the drop height of the heavy handset replacement simulator is adjusted by Technical Officer Tony Knight.

Below, right: Mrs Sue Duxberry, Drawing Office Assistant, prepares a highly accurate scaled printed wiring board diagram from which the manufacturer will eventually produce the desired component.



in fact, a contractor to the Post Office.

The disciplines will ensure the design evolves in an orderly and controlled manner, and that this can be demonstrated to all interested parties. The amount of control will depend on the project involved – the simpler the project, the fewer the controls. The control measures themselves should be documented in a design quality plan. This plan will say who is responsible for what in the designer's organisation, and will cover such points as design review meetings, and analysis of the design for failure modes and their effects, worst case stresses, novel or untried features and redundancy.

It will also involve safety of the design; facilities for the maintenance of the equipment; documentation control; and testing of prototypes by performance, environmental, accelerated life and endurance tests. Finally there is reliability assessment and demonstration on prototypes of the ability to produce. As soon as the design has been completed to general satisfaction, and perhaps after a final design review it can be passed for production.

Once having settled for a good and potentially reliable design it is vital to organise bulk production so that this potential is realised. At this stage there are three techniques to be considered. Firstly, normal manufacturing quality assurance methods are essential. These provide for such things as monitoring the product along the production line, control of incoming goods and materials and the action to be taken in the event of a quality failure.

The second technique is known as burn-in. This is optional depending on whether it is cost effective. Its aim is to provoke failure in those items which otherwise would have failed early in use, without affecting the reliability of those which are left. This means that the stress levels and duration of the burn-in tests must be carefully chosen to have the required effect.

The third possible feature is a reliability demonstration, performed on those items which survive the burn-in. This will often involve an accelerated life test. Both the burn-in and reliability demonstration should be written into the specification for the item.

Methods of installation, use and maintenance should take account of the failure modes foreseen in the design analyses and any unsuspected ones brought to light during production. The burn-in and reliability demonstration can provide very useful information here. It is also necessary

to monitor the performance of an item during its service life or else it will never be known if all the effort put into its design and manufacture has been worthwhile.

If it has not, then clearly something needs to be changed. This attitude of critical appraisal lies behind much reliability work. It is also essential that problems discovered at any stage of the product's life should be traced back so that their cause can be eliminated – by changing the design, manufacture or operational methods. This makes proper data collection and analysis a vital element in any reliability programme. The data and the analysis will also be useful to future design studies.

Several of these principles are being put into operation during the continuing development of the telephone. Field failure data gives a fault report rate of about 0.32 faults per station per year, of which 0.23 are cleared by a faultsman's visit. Of the remainder, most are found to be right when tested. It costs slightly more than £10 a time at current prices for each visit a faultsman makes to a subscriber's premises. As there are more than 23 million telephones now in use in Britain, this represents a substantial annual maintenance bill.

In an effort to cut this it was decided to identify the major failure modes of the most commonly used telephone, and then try to remove them by modifying the design. This identification of deficiencies was controlled by Telecommunications Development Department's Value Analysis Division. Together with the Customer Apparatus Division and Quality Assurance Division (QAD) of the Procurement Executive a test programme was devised which was carried out by QAD laboratories in London and Birmingham. It involved several standard environmental tests, such as storage in a humid atmosphere, and vibration. There were also adapted versions of tests performed by some foreign telephone manufacturers, such as simulating heavy replacement of the telephone handset (used by LM Ericsson in Sweden).

Tests were made on complete telephones and on various components such as the transmitter (microphone), bell and dial. Electrical, mechanical and acoustic measurements were made, and the performance of some foreign telephones was compared with those of British manufacture and those repaired by Post Office Factories Division. The foreign phones came from Sweden and Germany and dials from Italy were also tested. Analysis of the results showed several points on which the performance of the British telephones could be improved.

Tony Knight removes a batch of telephones which have undergone climatic storage tests.

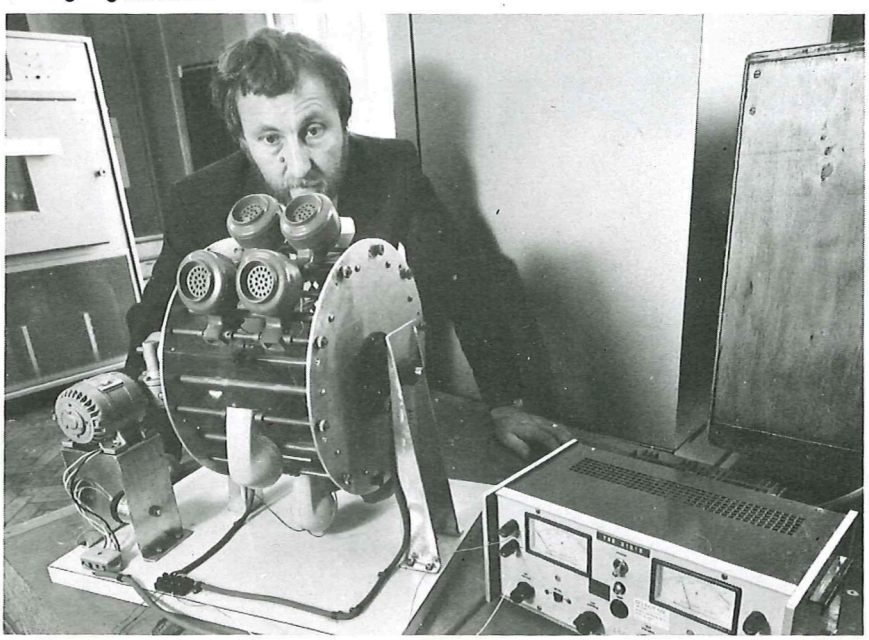
Subsequently, a contract has been let to Plessey to improve the design of the telephone, based on the findings of the test programme. Among other things changes were proposed to the gravity switch and its operating linkage, to the regulator and to the bell, in which a volume control was to be included. The result of this design contract will be some samples and several complete sets of drawings. Quantities will then be made for a field trial, following successful conclusion of which, production is expected to begin.

This continuing development of the standard telephone instrument will be built upon to produce a design for the New Generation Telephones. These, the standard telephones of the future, are expected to be keyphones incorporating a micro-electronic chip. The design project is already under way, and the new telephones should be in production by 1982. Industry is showing an increasing interest in design control measures, and there is every chance of looking forward to a period of increasingly reliable telephone operation, with lower overall costs to the Post Office.

Mr R. Millard is an Executive Engineer in the Quality Assurance Division of the Procurement Executive responsible for developing reliability assurance techniques.

PO Telecommunications Journal, Summer 1979

Assistant Executive Engineer Alan Hill keeps a close eye on telephone transmitters undergoing shock test treatment.



The way ahead

In this second of his two articles on the inland operator service, **Mr C. H. Makepeace,** Head of Operator Services Division in THQ Marketing Executive takes a closer look at how the existing service is provided, the part played by Operator Services Division and where the service can lead in the future.

AT THE END of March this year, the number of inland telephone operating staff totalled almost 31,000 and accounted for about 85 per cent of the Post Office's total operating force. Inland operating work divides into four main areas: controlling and assistance – that is connecting calls between customers; general enquiries; directory enquiries and clerical duties.

Until fairly recently, controlling work has been predominant, but directory enquiries (DQ) have been growing steadily and will soon take the lead. Non-operating work, most of which is clerical, currently employs 23 per cent – about a quarter – of the operating force, at a cost of around £40 million per year. These operators provide a reserve which can be used to augment switchboard staffing to meet sudden peaks of traffic.

But exchange clerical work is not an end in itself, and it exists only to support operators. Furthermore, since clerical work includes an additional pay allowance the most senior and experienced operators, who would be of more value dealing with customers, naturally gravitate towards it. One of the Operator Services Division's tasks is to keep this work under close review and try to make it more efficient – for example by computerisation.

The DQ service can be regarded as essential because a caller who lacks both the number of the person or firm he wants to call and access to the appropriate directory has to use the service if he is to make a telephone call at all. It is expected within the next few years – the only uncertainty is how quickly it will come about – that the situation will be reached where DQ becomes the predominant service. Because of this a major effort is in hand to improve its quality and efficiency. The possible introduction of a charge for DQ, although not Business policy at present, would reinforce this need for a high quality service but the cost would still need to be kept down.

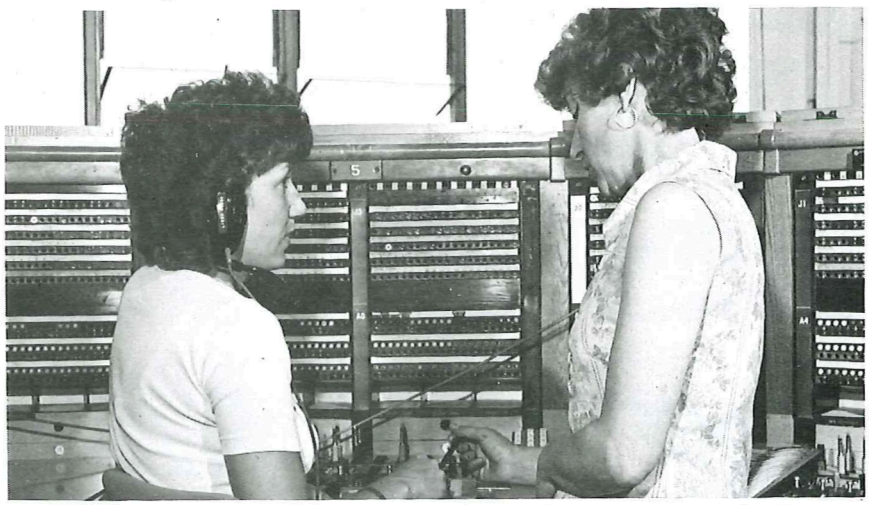
At present inland directory enquiries, which last year employed 8,200 people and cost about £44 million, depend on operators looking up number information in paper records. These are a combination of normal public directories for distant parts of the country about which enquiries are less frequent and computer produced directories for local, adjacent and other frequently called Areas.

The directories to which each operator needs access occupy about 2.25 metres of shelf space. Their bulk is growing by about eight per cent annually, reflecting the expansion of the system and progressive consequential sub-division of public directories introduced to reduce costs. The quantity of paper records required has already reached the limits of existing space on operator positions and there is virtually no scope to provide additional storage within reasonable reach.

Traditionally the Post Office has used a single access number code (192) for all inland directory enquiries. Dividing the country to reduce the quantity of records needed by each operator would require callers to identify the location of their required number within the terms of the system and dial an appropriate code. Alternatively operators could forward calls they could not handle to another centre. Either of these methods would worsen the service to customers, since many enquiries would take longer to handle because some would inevitably go astray. Experience in London, where callers dial 142 for enquiries in the London Postal District and 192 for numbers elsewhere, does not really encourage wider application.

The obvious answer, which many other administrations have adopted, is to hold directory information on computer file and equip DQ operators with terminals to access data. Currently a trial of a Directory Enquiry Computer Information Retrieval (DQCIR) system is being conducted in Leatherhead and Leeds. This system uses ICL's Content Addressed File Store working to a 1900 computer at Bracknell. Although most operators prefer the system to books it has now become clear that they will require time to unlearn existing search strategies and develop skill in using the computer.

Call handling time and successful response percentage measurements have shown a promising improvement over books. By December it is hoped to frame and agree proposals for the next step – a pilot scheme – based on the experience of the trial. The pilot scheme will enable a full scale system trial at a number of centres and should provide well-based justification for a move to a national system. Such a system would probably cost over £30 million, and a commitment on this scale would afford firm evidence of Post Office intentions to sustain an operator service in the forseeable future.

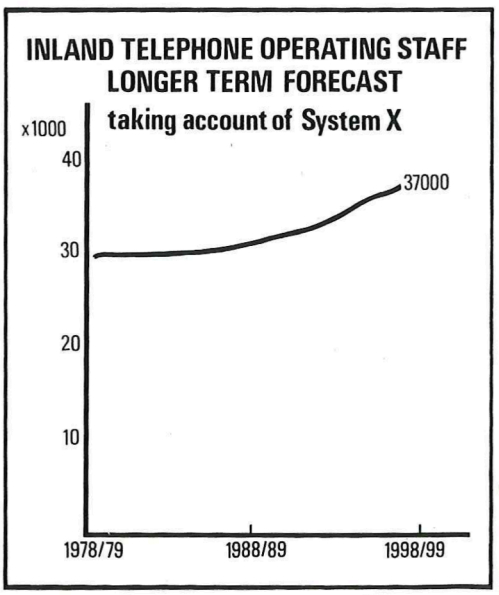


Telephonist Mrs Linda Woods discusses a call problem with supervisor Mrs Marion Willson at Waltham Cross Exchange, Herts.

DQCIR offers real potential benefits for both customers and staff. It should provide a better and ultimately cheaper service, while improving the operating environment. Introducing computer terminals into switchrooms also provides scope to use them for other operator-provided information and controlling services, and points the way towards the operator assistance centres of the System X era.

Introduction of a national DQCIR system would take place progressively, probably over several years, as there are almost 300 centres to be converted. Any national DQCIR scheme will require a massive on-line computer access system with very large files, and demand exceptional reliability in service. Implementation proposals will have to accord with the overall Business computer strategy for the 1980s. It is planned to complete these by the end of this year.

Meanwhile, the problem of managing paper records on operator positions is pressing and demands an urgent solution. Last summer a review concluded that on the fastest reasonable timescale for national introduction of DQCIR, the resulting degradation of service from continued use of growing paper records prior



Top: Answering 999 calls is a vital part of the telephone operator's work. Here quickly responding to the red lamp warning of an emergency call is Ilse Cotton at Colchester Exchange.

Above and left: The increase in volume of traffic on the DQ service has led to the Post Office developing microfiche and computer based information retrieval systems to replace the traditional but very bulky book method. Above an operator searches through a selection of books to help a customer while below operators are at work using the computer information retrieval system.

to conversion was unacceptable. It was decided therefore to introduce a manual microfiche system as an interim measure during 1980.

Although only a temporary answer, microfiche is expected to bring useful service and productivity advantages to customers and staff. The files to hold the full national microfiche record occupy only 75 centimetres of shelf space, leaving room for extra fiche catering for many years' growth before more are required. As well as being more pleasant to use, microfiche will increase the proportion of enquiries which operators can answer positively, without recourse to a colleague at a distant centre.

Fiche information for the whole country, rather than just the local district, will be provided in computer produced form, which can be updated weekly and reprinted every 13 weeks. In this way information about distant areas will be provided in a form significantly more convenient, up-to-date and accurate than the public directories used at present.

Relaxation of the space constraint will allow provision of more street order listings for common names, speeding and facilitating the operator's task. A significant productivity gain also arises from the reduced cost of producing fiche as against paper directories, and this will pay for the whole investment in microfiche viewers inside three years. As a bonus it is hoped that a modest improvement in handling time will result, which would bring further benefits to customers and staff.

Controlling operating, the straightforward call connect service, is no longer as vital as it once was. The service that remains embraces both the few calls which customers cannot yet dial themselves, and those instances where callers choose to have the operator connect the call for them. The former class will disappear this year with the exception of calls to some exchanges in the Irish Republic. The latter come mostly from customers who are still not reconciled to a Do-It-Yourself telephone system.

The next important category – caller encounters difficulty – reflects the current performance of the automatic system. It is to be hoped that the introduction of Measurement Analysis Centres (MACs), and ultimately System X, will improve matters.

Next there are 999 calls, a small but very important part of the workload. It might well be that at some time in the future Post Office operator involvement in connecting these will disappear, and they will go direct to an emergency control centre. An important pre-requisite of such an arrangement would be a highly reliable automatic system with the facility for the control centre to hold the call, and a system of calling line identification linked to a computer to provide address information. This will be some time in coming.

Finally comes the largest block of controlling traffic, facility calls and in particular transferred charge (XFC) calls. These together make up 60 per cent of controlling traffic. In dealing with these one course of action followed in Germany, Holland and Scandinavia is to pursue a policy of minimising operator-provided call connect services because they are difficult or impossible to provide economically, represent an avoidable management burden and are only used by a minority of customers.

Present Post Office policy is intended, as far as possible, to maintain freedom of choice for customers. In providing call facilities, however, it is also the aim to fix prices at levels which enable the Post Office to cover costs and make a proper contribution to overall profit. For this policy to have any hope of success everything possible needs to be done to keep down real costs. The chief cost is people, and so ways have to be found to improve operator productivity. This means reducing the time taken to handle calls. To achieve this, a field trial of Automatic Call Recording Equipment – ACRE – is being conducted at Eastbourne.

This equipment, developed within the THQ Network Executive and engineered for production by Standard Telephones and Cables Ltd., (STC) has two main functions. Firstly there is no need for operators to make out tickets because ACRE works out the charge step and tariff period. Then it takes over the call timing and outputs data at the end of the call on to magnetic tape for direct despatch to the data processing centre. After processing, the information is sent on to the billing computer.

Secondly the use of ACRE means that an operator need only use a Visible Index File (VIF) to look up STD codes. It also has useful functions to assist the operator with Advice of Duration and Charge and Credit Card calls. For the latter it checks the number given for validity, and looks up a stop list. Overall the scope for productivity improvement is considerable.

Once basic ACRE functions have been proved it is hoped to extend the trial to enable controlling operators to interrogate enquiry service state of line records, held locally in a data store. This will be particularly useful in dealing with assistance calls.

In its present form ACRE is adapted only for CSS1 positions. But there is little point in introducing ACRE for CSS1 exchanges if cord type AMCs still have to continue using tickets, since one aim is to end the costly ticket processing facility run by the Data Processing Executive (DPE). Because of this THQ Marketing Executive are considering a form of ACRE which can be attached to cord boards by the replacement of the keyshelf.

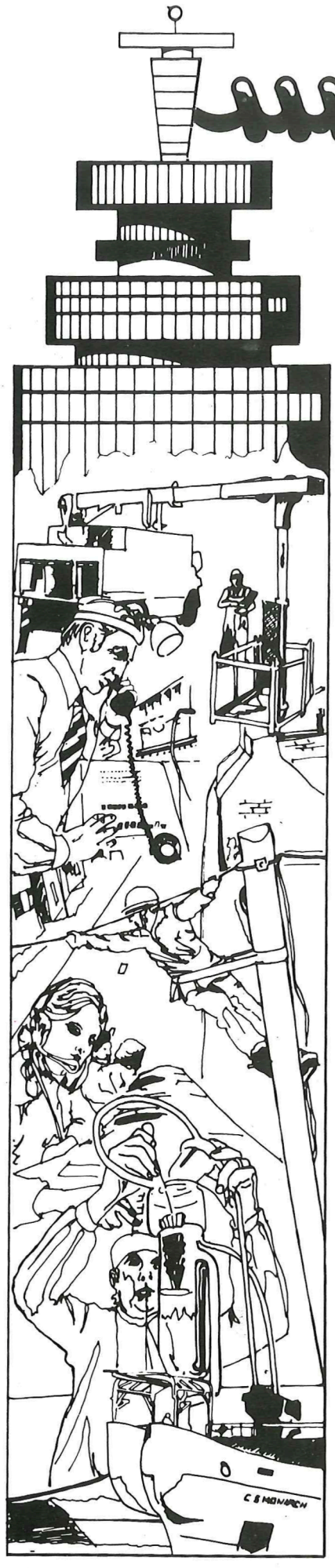
The third element of operating is enquiries – EQ. This function has become something of a Cinderella in that it has received much less management attention. There are no measures of answering performance, the system for assessing staffing is antiquated and there is relatively little information available about the make-up of work.

Detailed studies are now in hand, and when the information has been analysed it should then be possible to determine how best to improve the efficiency of EQ operation, using ACRE or DQCIR as appropriate. At the same time a field trial of special equipment is being conducted at all types of automatic exchanges, which will provide a call transfer service throughout the local call area, under the customer's control and without recourse to the operator. Trial of an automatic system to give customers changed number information (CNI) is also planned.

And what of the future impact of System X? Operators will clearly still have a role to play, and this could grow as the system presents customers with new and more complex DIY facilities. The introduction of System X will be a gradual process and there is not yet enough information available to outline the future shape of the System X operator control centre. But development work now in hand will help refine ideas, and move towards a working prototype in service perhaps by 1983.

Two other major areas of operator policy active at present remain unmentioned. One is AMC planning and provision strategy, where ideas of the right sort of place to put an AMC, and how big it should be, are being discussed. The other is the vital area of personnel policy, embracing recruitment, training, grading, progression and the organisation of exchange management.

Both these studies are important for the longer term health of the operator service. If they are to be right, as clear a view as possible of the nature of the service, and the problems it will face in 10 to 20 years time will be needed. Work is progressing in these two areas, and it may be possible to discuss them in future issues of the Journal.



Operating smoothly

Following the theme of the preceding article, this, the tenth in our series on some of the many different jobs essential to the efficient operation of Post Office Telecommunications is by **Miss Barbara Molyneaux** and describes her work as a telephonist at Warrington Exchange in Liverpool Telephone Area.

Miss Barbara Molyneaux.

IT IS NOW nine years since I first reported to the telephonists' training room at Warrington Exchange and I can honestly say that it does not seem a day too long. Indeed it would be hard to imagine working anywhere else or being anything other than a Post Office telephonist.

Telephones have, in fact, always fascinated me, and as a small child my father made me one from a piece of wood, two old wireless knobs and a length of flex. When I first left school I wanted to work as an operator but at that time I did not measure up to either the minimum height or age requirement.

When I tried again three years later as an 18-year-old it was a different story, and after waiting on tenterhooks for several weeks following my interview I finally received a letter of acceptance; my childhood ambition was about to be fulfilled.

Basic training was extensive and for a time I doubted I would ever be able to remember everything. But after several weeks of interesting and explicit attention from my very patient supervisor, it all seemed to click into place. A few months later I was working with a co-ordination I had never thought possible at one time.

A telephonist's day-to-day routine varies tremendously making it almost impossible for two consecutive days to be the same. Each brings its own fresh events which means interest never flags. Throughout the day a telephonist comes into contact with a wide variety of customers. They range from the busy executive to the housewife, or from the lonely pensioner to the stranded motorist. All need operator help of some kind and this is apart from any other emergencies which may occur at any time during the day or night.

Callers can often be very ill-at-ease and unfamiliar with using the telephone, or quite the reverse. It is essential therefore to be aware of such situations from the outset, to be able to provide proper assistance. It is important to avoid aggravating a knowledgeable customer while nonetheless offering more detailed guidance to a less confident caller. A telephonist's main asset is to have a pleasant manner and helpful tone of voice.

After about six months of working experience the telephonist is ready for the next stage of training. Operators are made familiar with Directory Enquiry (DQ) duties. Training is by no means as

involved as the initial course but equally important. Here they are taught to extract from the subscriber as much detail as possible to help locate the required number in the shortest time. They must conform to the set time allowed for DQ calls so it is vital that conversations do not stray too far away from the official phrasing designed to provide a speedy and accurate service.

Between three and six months after the DQ course, further training begins in the handling of fault enquiries. Here the operator is readily available to test numbers which appear to be faulty, and to help subscribers having difficulty in obtaining a telephone number, which they have tried to dial but without success.

Operators have the facilities and records from which to determine whether or not the line in question is faulty. Engineers are also at hand, working in collaboration with operators, and between them they can offer a reason as to why a number is not responding. If the line is proved to be faulty then arrangements can be made to have it promptly repaired.

I enjoy working in the telephone exchange for many reasons. There is no time to be bored. By the time familiarity with one stage of training has been achieved, the next is due. And as soon as an operator is fully experienced there comes the chance of promotion.

There is always a wide variety of colleagues who work in the exchange and age groups vary from the school leaver to the more mature. This means that whatever age a "new" telephonist is there will be plenty of opportunities to make friends. And off duty there always seems to be something happening on the social scene, whether it is a dance, an outing or a sponsored walk.

Nowadays when I see new trainees on their first day, my thoughts always return to my own beginning and I think back to my first morning, try to welcome them as warmly as I was once welcomed. They are starting a job which never ceases to fascinate.

Top, right: Tea-break time and Barbara joins colleagues for a friendly chat.

Right: Barbara hard at work in Warrington Exchange.

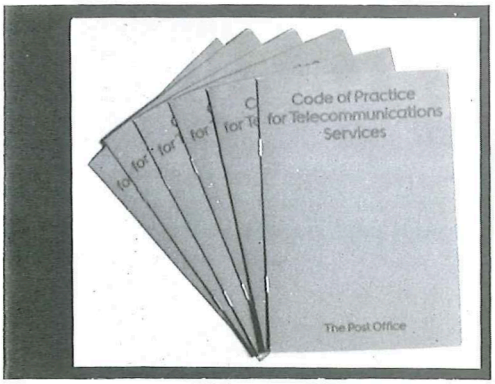
Codes for customer relations

CL Markus

Above, right: the recently issued Telecommunications Code of Practice.

Above: Mrs Stella Mayhew, a customer in North London, calls in to her local sales office to discuss a telephone problem with Clerical Officer Diane Stone.

Left: Paddington Telecommunications Traffic Superintendent John Flight (right) discusses billing and switchboard situations with Tim Wilson, building services manager at Constructors John Brown.



ONE OF THE more constant trends of the past few years has been the growth of the consumer movement. This has led to pressure for changes from a variety of quarters and, already, there has been a welter of new legislation most of it designed to protect the consumer.

The Post Office, of course, has not been immune. Indeed, the Telecommunications Business is well aware that consumerism is here to stay and welcomes the opportunities it brings for improving customer relations – and developing its own commercial wellbeing. The intention, in fact, is to develop more open relations with customers, and to look critically at service, policies and performance. The development of this more open policy has already begun with the publication of quality of service information and the launching of the Post Office's Codes of Practice.

Briefly, the Codes, one for Postal Services and one for Telecommunications Services, explain what sort of service customers can expect, what can be done to put things right if they go wrong and where they should go for help when problems arise. The Codes provide an excellent opportunity to show customers that the Businesses want to help them. They are not an end in themselves but merely a foundation on to which an improved customer relations strategy can be built.

The Codes of Practice have been drawn up in close consultation with the Post Office Users' National Council and the Office of Fair Trading and have their origins in the Unfair Terms Contract Act which came into force in February 1978. The Act requires that clauses in contracts or agreements should be subject to the test of reasonableness. This means, for example, that if a dry cleaning firm loses or damages an article it can no longer avoid paying compensation by pointing to an exclusion clause on the cleaning ticket if a court of law thought these conditions unreasonable.

Because some MPs saw the Post Office's limitation of liability as being typical of the kind of unfair terms which the Act was designed to prevent, Parliament took time at the committee stage of the bill to consider the Post Office's unique position under the 1969 Act which limits its liability in law and makes it impossible in most instances for customers to obtain compensation through the courts for any consequences resulting from service failures.

Had the Post Office Act been changed the Corporation would have found itself in a worse position in respect of liability than most other businesses because it could have been liable for any problems resulting from every delayed letter or misrouted telephone call. It was accepted that this would have created an impossible position and it was decided not to include the Post Office in the Unfair Contract Terms Act. The Post Office realised, of course, that customers had a need and a right to know what to expect when they used its services and what they could expect in the way of reparation when things went wrong. It was this which led to the issue of Codes of Practice.

In the Telecommunications Code an attempt has been made to cover several aspects of customer relations. There is a statement of the general service objectives of the Business which is supplemented by the regular publication of key performance statistics on such items as plant performance, repair service and operator services. This is considered important as the customer has a right to know what service to expect and it is to the Post Office's advantage to make this known as in many respects performance is better than generally believed. Conversely, where there is a failure, there is nothing to be gained by trying to conceal it.

The Code also contains a description of how the Business is organised at local level and this is intended to help customers overcome the initial difficulty that many experience in highlighting their problems. It is felt that many customers in the past have been reluctant to raise problems because they did not know whom to approach. If customers can be directed to the right people this should result in increased customer satisfaction.

Most of the Code is taken up with listing the more common difficulties which customers are likely to experience and explains what will be done to put things right. Many customers do not realise that they can get their money back in certain circumstances; for example if their telephone is out of order for more than two days after it has been reported to the engineers they can claim a rental rebate. This is a failing on the Post Office's part. It is now recognised that where there are reasonable policies they must be publicised if customers are to be satisfied.

At present most of the provisions of the Code do no more than reflect current policy but there is one very significant innovation – the creation of an independent complaints panel. This means that for the first time a customer with a particular sense of grievance can, where all else fails, have his dispute resolved by the panel whose members are drawn from Fellows of the Chartered Institute of Arbitrators. This is particularly important in view of the Post Office's monopoly position and the fact that customers, as a rule cannot sue the Corporation.

Obviously the Business tries to be fair to its customers but realises that if it is to be seen to be fair it must give them the chance to take their complaint elsewhere for independent adjudication. In many ways this could make things easier for, inevitably, not all our customers are reasonable, and not all see the Post Office as being reasonable. The Complaints Panel will help both sides when dialogue breaks down.

The Post Office regards the Code of Practice as one of the most important documents it has issued and great store is set by it. For the first time policies are being stated for all to see and as long as words are reinforced with suitable actions, customers should be satisfied. Since the Code will have a significant effect on customer attitudes it is being publicised to the full.

All staff have received personal copies and there has been a series of articles in staff journals. In addition to national press advertising all customers will receive an abridged version of the Code in their telephone bills and copies of both the Postal and Telecomms Codes are freely available from Telephone Area Offices and Post Offices. It is also planned to reproduce the Telecomms Code in full in all telephone directories.

Inevitably customers will be more aware of Post Office policies and aims and this must result in more enquiries and complaints. This is welcomed because it will give the opportunity, to create more satisfied customers and the more satisfied customers there are the fewer will be the enquiries and complaints and the better customer relations.

As Mr Peter Benton, Managing Director, Telecommunications recently stated: "We have nothing to lose – but everything to gain from the Code of Practice".

Mr C. L. Markus is Head of Service Policy Division in Service Department at THQ and was responsible for producing the Telecommunications Code of Practice.

PO Telecommunications Journal, Summer 1979.

Moving ahead underground

Engineering Instructor Mick Moore from Bletchley makes a telescopic sighting to ensure accuracy before the thrustborer is launched. This is the 130 mm machine.

D W Garrard

A multi-purpose trenching, excavating and ploughing unit to facilitate the laying of underground cable and duct was described in the last issue of the Journal.

This article traces the development of a pneumatically driven thrustborer which is being used for similar work.

THRUSTBORING, a technique for installing telephone duct or cable beneath roads, railways or other surfaces which must not be disturbed, has been available to planning and works engineers for many years but unfortunately early machines were unpredictable and liable to deviate from the required course.

Naturally, with this lack of confidence in the ability of the machine to stay on course, many engineers were reluctant to use it except in the most straightforward situations. The result

has been that many jobs have been tackled by expensive opencut and reinstate methods.

Several different thrustboring techniques have been tried over the years, with varying degrees of success but common to all was an inability to cope with obstructions and the probability of deviation, when conditions were less than ideal. Civil engineering contractors have made use of pipe pushing machines whose technique is pure thrustboring with no rotation of the in-ground machine and until now Post Office thrustboring machines have been of this type.

The auger borer, for instance, rotates and bores a hole underground with the spoil from the bore being carried back into the starting pit. Following on from this is the compaction type, where the ground is pushed outwards and compacted by a rotating mandrel to form a bore hole. A third type, the impact hammering thrustborer, operates simply by hammering across from one pit to another splitting and compacting the ground outwards as it travels forward.

Of the three, the hammering type has been the most successful but it required a specially designed nose cone capable of chiselling through obstructions such as rock and brickwork and a construction which would absorb the shocks of prolonged hammering activity.

A development based on this has now been adopted by the Post Office following successful field trials in Eastern Telecommunications Region. Known as a Grundomat 65, the new thrustborer is pneumatically driven and incorporates all the modifications and design advances necessary to ensure stability and the ability to cope with underground obstacles. It is capable of producing a straight accurate bore hole 65 mm in diameter in most ground conditions and it can install duct or cable as the bore is produced.

Consisting of an 850 mm long body tube with a nose assembly fitted at the front and a pulling skirt at the rear, its overall length is 1100 mm. Internally there is an alloy steel piston and a simple control piston valve assembly. Compressed air at a pressure of 85–100 psig and a flow rate of 28 cfm is supplied to the back of the piston through a central hose attached to the control piston/valve assembly.

Final adjustments are made to the launching platform immediately before the machine begins work.

Expansion of compressed air causes the piston to accelerate along the body of the machine to the nose where it strikes the anvil of the nose cone assembly. The machine is driven forward by the internal blow and the piston returns by a recoil action to the rear of the machine ready to be accelerated forward again. The blow frequency for the 65 mm machine is 480 per minute.

Once launched, the machine is prevented from recoiling in the bore by earth pressure on the body from the 10 per cent or so shrinkage which usually occurs when a bore hole is driven into the ground. When it meets an obstruction the machine will continue to hammer without there being any appreciable progress at first. The stepped nose cone will, however, gradually nibble and split the obstruction clearing a passage through which the body of the machine can pass.

The machine is launched from a pit on one side of a crossing to another on the opposite side. Accuracy of launch is achieved by using a cradle carefully and securely stacked to the pit base and a system of telescopic sighting to a surveyor's pole on the far side. The launch platform is designed to give horizontal and vertical adjustment so that the machine can be set to start in the desired direction.

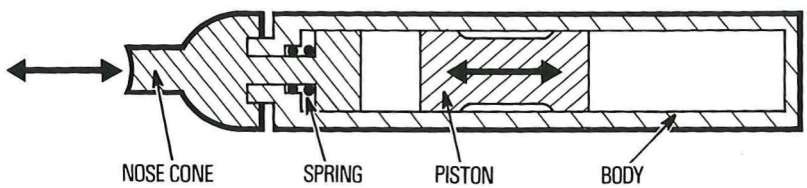
Because of the variety of ground conditions penetration speeds of the machine, with duct attached, will vary. But it can reach speeds of 20–30 metres per hour in clay, sand, loam and loosely packed ground. In heavily compacted ground or conditions where there are many obstructions, the speed will fall to one to five metres per hour. During the field trial 120 crossings were attempted of which 112 were successful.

Although the new machine comes in several sizes, the one bought by the Post Office for general use is 65 mm in diameter. A 130 mm diameter machine has also been purchased and this is being operated in conjunction with Bletchley Park Regional Training College on a national loan basis.

Since the machine has been in use a variety of crossings have been achieved. Of 20 projects tackled, 17 were completely successful and two were partial successes – achieving more than 50 per cent of the bore length. So far, nearly 1,000 metres of duct have been installed in this way.

One of the most notable exercises was a four-way duct installed under the A13 main road at Grays, Essex. The bore length of 16 metres was not particularly long compared with a 37 metres bore installed in Chester Area, but the four ducts at Grays were in horizontal formation with only 300 mm between edges.

Most of the time, traffic on the A13 was so heavy that it was difficult to use the telescope to sight across to the receive pit. But even with these problems the bores were installed with less than 0.5 per cent horizontal/vertical deviation over the whole length and, of course, none of the vehicles using the road was delayed by the underground work in progress.



How the Grundomat works: the hammering action is produced by the movement of the internal piston being forced forward by the expansion of compressed air and returned by the recoil spring fitted into the nose of the machine.

Mr D. W. Garrard is an Assistant Executive Engineer in External Plant Development Division of Operational Programming Department and is responsible for the development of mechanical aids for external works.

For Technical Officer Bill Spreckley, running the overnight IPSS accounting program requires one of the few manual adjustments to the system.

Packet switching goes international

TC Jones and AJ Lowe

THE LAUNCH last winter of the Post Office's International Packet Switching Service (IPSS) which gives UK and overseas organisations two-way access to computer data via telecommunications links, not only meets a proven customer demand but also puts the Post Office in the forefront of international data communications.

Introduction of IPSS follows the setting up of an inland experimental packet switching service (EPSS) and will be supplemented by the provision of an inland Packet Switched Service (PSS) early in 1980. The tariffs for this service were announced recently. When operational PSS will be interconnected with IPSS.

The great advantage of packet switching is that it achieves a more efficient utilisation of line capacity by interleaving data from different sources on to the same link at a rate that utilises the available bandwidth. The concept resembles store and forward technique but it is applied on a link by link basis. Users' data is broken up into packets for transmission through the network with each packet containing a maximum of 128 bytes (1024 bits) of data to which must be added routing and error control information.

The equipment used for the IPSS service is based on microelectric techniques and fully conforms to the relevant CCITT data recommendations. IPSS supersedes the successful trial Data Base Access (DBA) service which began in February 1977 (see Telecommunications Journal, Summer 1977) and which provided limited facilities for low speed data terminals to access United States computer facilities by dialling a London telephone number. The trial was used to ascertain user demand and enable the Post Office to gather a wide range of information to assess the viability of a possible permanent service.

Evaluation of the DBA indicated that a market did exist and a permanent service would be financially viable. The main objectives of the proposed new service, were to provide an enhanced range of customers' facilities following, wherever possible, international recommended standards; network control facilities in the UK to enable comprehensive statistical information to be collected, and full operational control to be exercised, and the early availability of equipment to replace the trial DBA.

In August 1977 the go-ahead for the new service to be installed was given. The project definition stage was completed three months later and a contract placed in January 1978 for provision of the new equipment. In just under 11 months from placing the contract, the service was launched.

IPSS is an integral part of Post Office planning for the introduction of public data services which include PSS and the opening of Euronet (see Telecommunications Journal, Summer 1976) this summer. Both IPSS and Euronet are co-located in the London International Data Centre. Between them they provide international data transmission between the UK European and Intercontinental destinations.

UK data customers gain access either

over the public switched telephone network (PSTN) or by direct leased line. They are able to establish calls to overseas computer facilities and enable foreign data customers to connect to UK computer facilities. In addition the capability for international data transit service has been provided. IPSS caters for asynchronous speeds operating at 110, 134.5, 150, 300 and 1200 bit/s, and synchronous speeds at 2400, 4800 and 9600 bit/s.

IPSS equipment checks the validity of callers using the PSTN access by inspecting an identifier, the Network User Identity (NUI) which consists of a 12 character password and which must be transmitted before entry to the Network Address (NUA) of the called customer. Both the NUI and NUA are used by the system to prepare customers' bills.

Billing and accounting statements for data calls originating from the UK will be produced by the IPSS equipment. The raw data is collected at the Network Control Centre (NCC) and is processed at off-peak times to produce call details, source data for customers bills and international accounting settlements.

The unit of billing charge and accounting settlement to be used for the volume of data transferred is the kilosegment, where a segment is defined as 64 bytes. The information is stored on disc for up to a month after which it is output on to magnetic tape for longer storage.

Customers can receive itemised bills giving details of each call including the calling and called addresses, the date and time of call set up and disconnection, the chargeable duration, and the number of segments transmitted. Additionally at the end of each call the customer automatically receives a print out of the call duration and volume of data transferred as a record number of segments sent and received for the call just completed.

The international accounting statements include details of calls, number of paid minutes and kilosegments transmitted and received for each monthly period. Collection charges are structured to include service connection, service rental, volume charge based on 64 byte segments, normal inland charges consisting of annual modem and telephone charges plus the PSTN call access charge.

An international numbering plan is used in accordance with CCITT recommendations. This is based on a 14 digit maximum numbering scheme consisting of a three digit country code (234 for the UK), a single digit network or service code (1 for IPSS), a three digit area code, a five digit customer number and two digits available to customers for the called addressing points. The full international address of the calling and called terminals are forwarded in the first packet transmitted by the originating exchange.

The first international connection is to the USA. This inter-connection consists of links between London and New York; one link to each of three International Record Carriers (IRC), Western Union International Inc (WUI), Radio Corporation of America Global Communications (RCAGC), and International Telephone and Telegraph World Communications Inc (ITTWC). The IRCs provided access to two domestic data networks, Telenet and Tymnet, as well as providing their own asynchronous and synchronous service.

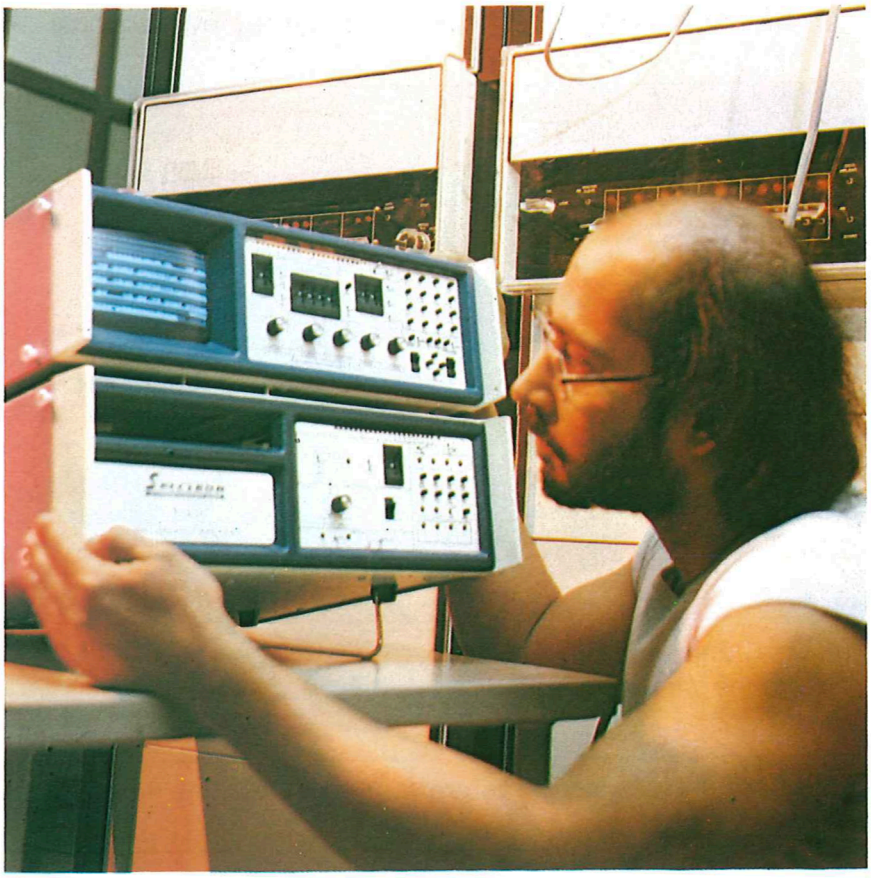
IPSS enables Data Terminal Equipment (DTE) to communicate on a Virtual Call (VC) basis. Terminals communicating via VCs are given the impression that connections are over a dedicated physical line. In actual fact the path is only established for the duration of the particular packet so enabling a single physical line to be shared by a number of users. Some DTEs, mainly computers, can exchange data packets directly with IPSS but most DTEs connected with IPSS are start/stop mode terminals which are not capable of handling information in packets. To accommodate these, the system provides a suitable interface known as a Packet Assembler/Disassembler (PAD).

The equipment used for IPSS consists of a main processor and a front end microprocessor based unit together with the Network Management Centre (NMC) processor. The main processor is a general purpose 16 bit mini computer with microprogrammed logic, synchronous line interfaces and 64k word of memory. Currently, international trunks operating at 9600 bit/s are connected although connections up to 64kbit/s can be accommodated. Two main processors are provided with one in service and the other acting as standby. Changeover occurs automatically in the event of failure.

The front end microprocessor is a third generation multi-microprocessor system whose basic function is to interface computers and terminals to the packet network. Its software conforms to the latest CCITT recommendations for connecting start/stop asynchronous terminals to packet networks and also supports facilities for synchronous transmission. This software includes facilities for VCs and network management functions.

The NMC is the nerve centre of IPSS, providing control over the network, maintenance information, loading of both main processor and front end microprocessor software, NUI validation, collection of billing and accounting information as well as a full range of network management information. The NMC functions as an on-line host computer and consists of a 16 bit mini computer

A full range of tests are available to detect errors in the system. Here Technical Officer Paddy Chatterjee checks the composition of one packet using a datascope.



together with several magnetic tape and disc units and input/output devices.

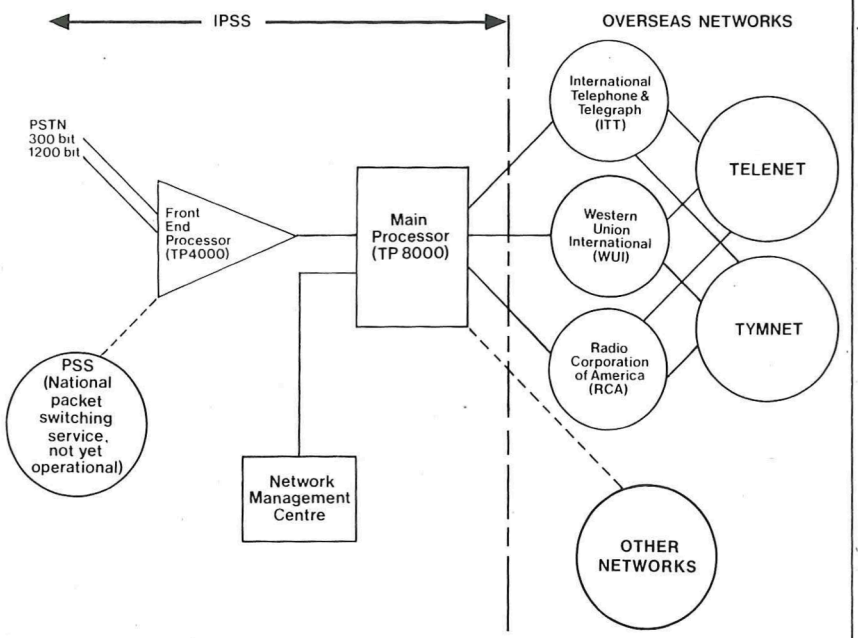
In summary, following comprehensive marketing studies into the growth potential of data services, the Post Office has had the opportunity to benefit from the experience of the trial Data Base Access service. This has led to planning for the IPSS service being based on a high annual growth rate with growth still further enhanced as IPSS is extended to more overseas destinations. The future of the service appears bright. From its beginnings as an interconnection between the UK and the USA plans are well advanced for its extension to Canada within a few months.

Longer term plans include interconnections to a wide range of overseas destinations and provision of facilities for interworking with other services. IPSS is evolving as a major gateway to overseas data networks and is thus helping to maintain the UK's advanced position in the field of international telecommunications development.

Mr T. C. Jones is Head of the External Data System Planning Group in ETE and **Mr A. J. Lowe** is an Executive Engineer responsible for data system planning and special projects co-ordination.

PO Telecommunications Journal, Summer 1979

THE IPSS SYSTEM



Quality of telephone service January to March 1979

Figures in brackets indicate performance during the previous quarter (October to December 1978)

		National averages	
Local automatic telephone service	Calls connected successfully	61.8%	(63.2%)
	Calls which obtain 'engaged' or 'no reply'	29.3%	(28.4%)
	Calls that fail due to the customer	7.0%	(6.9%)
	Calls that fail due to the Post Office	1.9%	(1.5%)
STD automatic telephone service	Calls connected successfully	62.4%	(63.9%)
	Calls which obtain 'engaged' or 'no reply'	25.4%	(24.7%)
	Calls that fail due to the customer	8.3%	(8.2%)
	Calls that fail due to the Post Office	3.9%	(3.2%)
Repair service	Yearly fault reports per telephone	0.68	(0.65)
	Fault reports cleared by end of next working day	*	(68.5%)
Inland telephone operator service	Calls answered within 15 seconds	83.9%	(86.4%)
International automatic telephone service (IDD)	Calls connected successfully	36.4%	(37.1%)
	Calls that fail in the international automatic exchanges	3.9%	(4.9%)
	Calls that fail due to other causes	59.7%	(57.5%)
International telephone operator service	Calls answered within 15 seconds	65.5%	(59.5%)

*Figure not yet available

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From Slipper Jack to System X

Britain's first telephone exchange at Coleman Street, London.

Britain's first public telephone exchange opened 100 years ago this summer at Coleman Street in the City of London – just around the corner from today's Telecommunications Headquarters in Gresham Street. To mark the anniversary, **Mr Peter Povey,** Curator of the Post Office's Telecommunications Museum at Taunton, recalls conditions in those far off, pioneering days.

SLIPPER JACK has the ring of a character from Dickens or Runyon but it was, in fact, the type of switchboard installed in Coleman Street Exchange when it was opened in August 1879 by The Telephone Company Ltd which had acquired the rights to use the patents of Alexander Graham Bell.

The switchboard was imported from Boston, USA, and was made by the firm of Charles Williams Jr. where Bell had done many of his early experiments. It only had two positions but nevertheless required three, or even four, operators to work it. Two sat at tables and spoke to the subscribers while another, or possibly two other operators, worked at a separate panel setting up connections.

Subscribers were connected with cords but instead of the plugs that were used with later switchboards, each cord terminated with a metal blade set in a handle made from insulating material. The blade and handle resembled a jack knife. The jack slipped under a spring on the face of the switchboard which was known as a "slipper" – hence its name.

Unfortunately, no photograph of the operators has survived but it would be wrong to imagine the demure Victorian ladies usually seen in later photographs. It was almost certain, in fact, that Britain's first telephone exchange was staffed by boys who soon earned themselves a bad reputation by playing too many pranks and generally causing mischief. As a result, by the end of the 1880s they were replaced by teams of young ladies.

When Coleman St opened there were only seven or eight subscribers but this number had risen to more than 50 within three months. All the telephone lines were overhead and were connected to a standard mounted on the roof of the exchange. Many of them could be seen crossing Moorgate St.

Shortly after the exchange opened the rival Edison Telephone Company of London Ltd, opened an exchange in Lombard St. This company used a completely different type of exchange and a telephone that had been invented by Thomas Alva Edison. The company also employed a young Irishman who had an unspectacular telephone career but later found world fame in a different sphere. His name was George Bernard Shaw.

The building housing the exchange at Coleman St was demolished long ago and even the street numbers have been changed but little more than a stone's throw away is the modern Moorgate Telephone Exchange which in 1971 was chosen for the field trial of one of the world's most up to date telephone systems. The exchange switched calls in digital form using stored program processor control – a feature of System X the Telecommunications system of the 1980s. Certainly it is a very long way removed from Slipper Jack and mischievious young boys . . .

PO Telecommunications Journal, Summer 1979

MISCELLANY

THQ reorganisation

The first stage in reshaping Post Office Telecommunications Headquarters to meet the challenges of the 1980s have taken place with the introduction of a new organisation down to Departmental level and the appointment of a number of new Directors and Heads of Independent Divisions. The aim is to complete the reorganisation within the new Departments by October this year.

In the new organisation six Departmental Heads, the Directors of Business Planning and Strategy, Data Processing Executive, Overseas Liaison and Consultancy, Prestel, Service and Performance, and Special Studies report direct to the Managing Director or his office.

Departments reporting to Senior Directors, are referred to as 'Executive' or 'Staff' according to the demands of their work. Five new Executives have been formed – Technology; Network; Marketing; International; Procurement and two Staffs – Personnel and Finance and Management Services.

Parallel reorganisations are under way for the International and Procurement Executives.

More details of the reorganisation, together with the new appointments, will be featured in the next issue of Telecomms Journal.

Prestel's Swiss role

Prestel, the Post Office's Viewdata service which uses a telephone line to access computer data and display it on a television screen, has notched up further success. Having already concluded sales deals in West Germany, the Netherlands and Hong Kong, as well as a deal with Insac Data Systems to provide a service in the USA, Prestel has now been sold to Switzerland. The contract covers the sale of software and, like previous deals, is for 'pilot trial' programs.

Compact available

A new telephone is being introduced this year at the lower rental end of the Premium range. Called the Compact, it is available in three new Post Office colours – blue, brown and light grey.

It is a two-part instrument, made up of a smaller-than-usual lightweight body and handset connected by helical cord to a separate bell unit. The bell has a combined volume control and on/off switch for use on an extension.

Keeping the score

Sports fans have once again been well catered for this summer with the Post Office's telephone information services. Results and details of all the top cricket games are available on 154 while tennis followers, were able to keep up with progress in this year's Wimbledon Lawn Tennis Championships from 8.00am each day of the fortnight.

Similar information for golf fans was also provided for the British Open Golf Championships. A pre-event message gave details of qualifying rounds, frequent updated reports were broadcast during the Championships and for two days after close of play a closing summary of results was available.

Transatlantic boost

A new £100 million telephone cable between Britain and the USA that will boost transatlantic telephone cable links by more than 50 per cent has just been given international go-ahead.

This giant undersea link, with a capacity of more than 4,000 simultaneous calls, will carry phone calls, computer data and telex messages between Europe and the USA and Canada.

The new cable is needed to cater for continuing massive growth in calls between the two continents, and in particular between the USA and Britain – the world's busiest transoceanic telephone route.

Manufacture of the new system – known as TAT 7, the seventh in a series of America/Europe cables that date from 1956 – will be shared by the USA, Britain and France. It is due to come into service in 1983 and will run 3,400 nautical miles between Sennen Cove (Land's End) and Tuckerton, New Jersey.

Land's End on the move

One of the most famous coast radio stations in the world – Land's End – has been moved to a new site at Skewjack, near Sennen, some five miles south-west of the old one at St Just. As part of the £5million Post Office programme to modernise and expand the maritime radio service, the new station costing £92,000 and housed in former RAF buildings includes the latest radio telephone and teleprinter equipment providing selective calling facilities.

Land's End Radio is the southernmost point in the medium-range coast radio station network. Last year it dealt with more than 41,000 radio telegrams; 63,700 ship-to-shore radio telephone calls and 2,600 radio teleprinter messages as well as 86 medical cases, 11 distress and eight urgent calls.

Exports boost

The installation of a new exchange at Werrington, near Peterborough, marked a deliberate Post Office move to boost UK telecommunications equipment manufacturers' export chances. The exchange, a Plessey Pentex, is the export version of the standard British TXE2 system. A complete exchange, in fully operational condition, can be shipped in an international freight container.

Telecommunications Managing Director Mr Peter Benton said the Post Office, dedicated to providing every possible assistance for British Industry's exports, was happy to co-operate in this way.

The Post Office has also provided another similar facility in installing a GEC export electronic exchange system at Clipston, near Leicester.

Contracts

Plessey Telecommunications Ltd and Data Systems Ltd – for a Plessey PDX, Private Digital Exchange, to be installed in the Telecommunications General Manager's Office, Exeter and expected to come into service early next year. The PDX is currently undergoing type-approval testing by the Post Office.

Plessey Telecommunications Ltd and Data Systems Ltd – for £1.7 million for telephone apparatus and switchboards including private manual branch exchanges, telephone handsets with special amplifiers for the hard-of-hearing and box connection units, for delivery next Spring.

Motorola Communications Group – for an additional 5,000 Pageboy II pagers to be used in the London area radio-paging scheme.

GEC Telecommunications Ltd, Private Systems Division – for £3.3 million for PABXs and associated switching and interconnecting equipment to be installed in various Government offices.

RFL Electronics Ltd – £39,000 for 30 speech and telegraph multiplexors to be used with Engineering Service Circuits on the second antenna at Madley Earth Station.

Racal-Milgo Ltd – £1.4 million for modems and associated data communications equipment for use in the Datel 4832 service.

GEC Telecommunications Ltd – £1.5 million for microwave radio equipment including 6.8GHz equipment to provide further extensions in the Shetlands for the North Sea Oil terminal at Sullen Voe.

Automation and Technical Services Ltd – £2 million over a five year period for the multiplexing equipment to be used in the ABC (Alarms By Carrier) service.

Plessey-BICC – £1.5 million as part of over £5 million of orders to be placed with Plessey-BICC, STC-ITT and GEC, for glass optical fibre transmission systems.

Film successes

Three Post Office Telecommunications films have won Certificates of Creative Excellence at the 12th United States Industrial Film Festival in Chicago, Illinois.

The films are "Pick up on South Street" an internal Telecommunications Business production lasting 14 minutes and aimed at encouraging safety awareness among engineers handling stores; "Take a firm line", a 19½-minute film intended to prompt business managers into ensuring their communications systems keep pace with company growth and the 24½-minute "The sea has many voices" a reminder of the part played by the Post Office in maritime communications – in regards to three men stranded in a fishing dinghy.

Introducing the "no excuse" Agitelco payphone.

From Agitelco – a member of the AGI Group of Companies who, over the last 15 years have supplied about half of all UK payphones – comes a new range of "no excuse" payphones that are very much the shape of things to come!

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a member of the AGI Group of Companies.

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Subsequently this also gained a certificate of special merit in the public relations and prestige category from the British Industrial and Scientific Film Associates annual sponsored festival at Brighton.

Safety at sea

In a contribution towards greater overall safety at sea for the nation's fishermen, the Post Office has provided an all-night listening watch on the frequency 2381 kHz. From 1700 to 0900 hours daily, one radio officer stands by, listening exclusively for trawlermens' calls. The watch is not intended primarily for distress messages – normally transmitted on 2182 kHz – but for position reports, local weather conditions and non-emergency breakdowns or mechanical problems.

Calling facilities are already provided on this frequency for all UK ships during the working week (including 0900–1700 Saturday) which avoids causing radio interference on the international distress frequency. The service began with Wick, Stonehaven and Oban Radios and is due to be extended to other stations.

Welsh rally

Reports and information on the progress of the 1979 Welsh Rally were available from 49 phone centres throughout the UK, 32 more than last year when only a local Welsh service was provided. Details on the build-up of the two-day rally could be heard before the start, while results and final positions were available for the following week.

Building for the future

The Post Office's massive new telecommunications complex at Baynard House, next to the Mermaid Theatre, Blackfriars, London, has been handed over to Managing Director, Telecommunications, Mr Peter Benton, well within both financial and timescale targets.

Baynard House, named after the castle built by William the Conqueror in the 11th century, just under the south-west corner of the City defences, will play a key role in taking Britain's telecommunications network into the 21st century. It will be London's first building to receive System X and eventually will house nearly £100million worth of equipment, including a Prestel computer centre, the Post Office National Telecommunications Museum and local digital and TXE4 exchanges.

New pension fund head

Sir Daniel Pettit, lately Chairman of the National Freight Corporation, has been appointed Chairman of the Post Office Pension Fund. He took over from Mr Alfred Singer, Chairman of the Fund since 1977.

Sir Daniel, 64, is a graduate of Cambridge University and a member of the MCC who represented Great Britain in the Berlin Olympic Games of 1936.

Phone-rangers

Children aged between 10 and 14 are proving keen to join the Post Office's new Adopt-a-Phone-Box Scheme, run in conjunction with schools.

Children sign on as phone-rangers and receive a Wild West-style marshal's badge and certificate and notebook checklist, to fill in as a record of the conditions of the adopted kiosk. The booth will be on the child's route to school and it is hoped that daily checks will lead to speedier maintenance and higher cleaning standards.

Link for oil men

One of Britain's most isolated North Sea oil platforms will soon be coming in from the cold with a £7 million Post Office telephone system. Under a £750,000 contract placed by the Post Office with Marconi Communication Systems Ltd, special radio equipment will be provided for North Sea oil men on the Shell Fulmar platform to telephone and telex almost anywhere on earth.

The link will be the longest system so far provided by the Post Office for the offshore oil and gas industry and will be completed in the autumn of next year.

This important service employs an advanced technical system known as the tropospheric scatter technique and will operate between the transhorizon radio terminal near Fraserburgh, in north east Scotland, and the Shell Fulmar oil platform, 280 km away. The development marks another stage in the offshore oil and gas communications programme and will provide the most efficient facilities for Britain's largest developing industry.

Transhorizon radio operates by beaming powerful microwave radio signals high into the troposphere where they are scattered by atmospheric turbulence. A small but usable quantity of these dispersed signals reachers the aerials on "master platforms", which maintain line-of sight radio links with other production platforms in the area. The radio stations are connected by private circuits to customers' offices, control centres and supply bases and also to the public switched telephone and telex networks.

In this way platforms can dial direct to 400 million telephones in 85 countries and to some 800,000 telex users throughout the world. The Post Office North Sea transhorizon network is the only tropospheric scatter network in the world to offer subscribers these facilities.

TXE2 at the double

At the official opening of the 1,000th TXE2 electronic exchange at Hagley near Birmingham, Managing Director, Telecommunications, Mr Peter Benton prophesied that the number of electronic telephone exchanges in Britain would double during the next five years.

He said the new exchange was part of £1,000 million a year investment programme, enabling the Post Office to provide a better service for more people. Installation would continue at an overall rate of more than four a week and the Post Office was funding virtually all from its own resources.

Chairman's degree

Post Office Chairman Sir William Barlow has received an Honorary Degree of Doctor of Science from the Cranfield Institute of Technology at a joint ceremony with Sir Frederick Page, CBE, Chairman and Chief Executive of British Aerospace Aircraft Group.

FR ELECTRONICS

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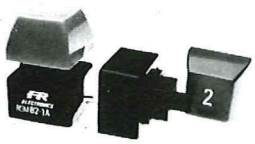
RSM 82 LOW PROFILE KEYBOARD SWITCH.



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For the first time ever, five major British telecommunications companies have joined forces with the British Post Office to demonstrate that Britain still can lead.

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At TELECOM 79 – where the British System X will make its international debut – the Post Office and five other companies – GEC, Plessey, STC, Marconi, and Pye TMC – are presenting a wide range of British telecommunication skills, including digital transmission systems and customer products and services.

More proof – if it's needed – that Britain competes.

British Telecommunications gets ready to show the world

GENEVA 20–26 SEPTEMBER

The British Post Office
GEC Telecommunications Limited
The Plessey Company Limited
Standard Telephones and Cables Limited
Marconi Communication Systems Limited
Pye TMC Limited

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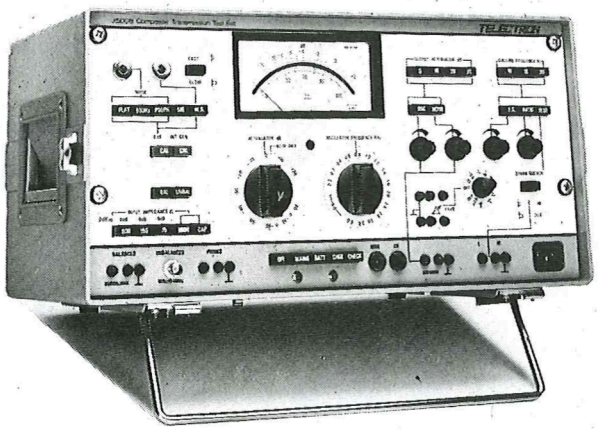

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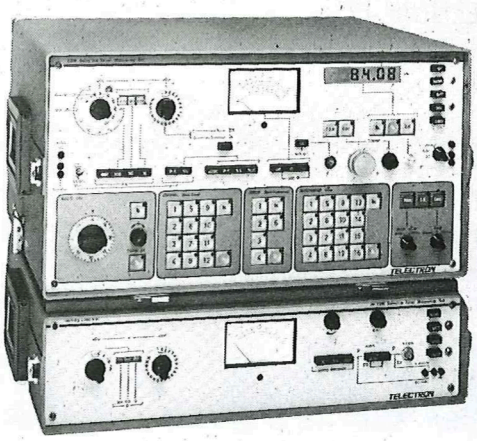

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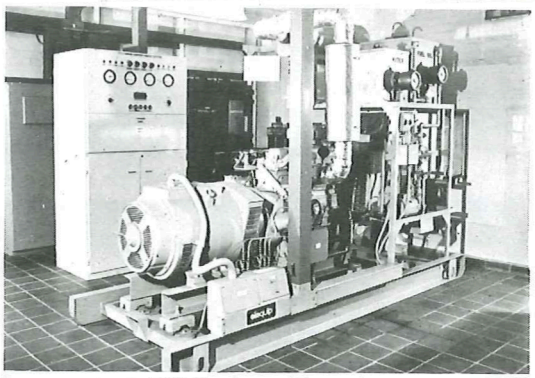

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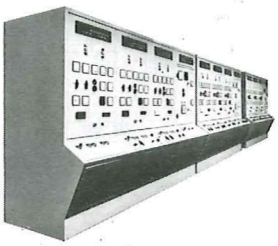

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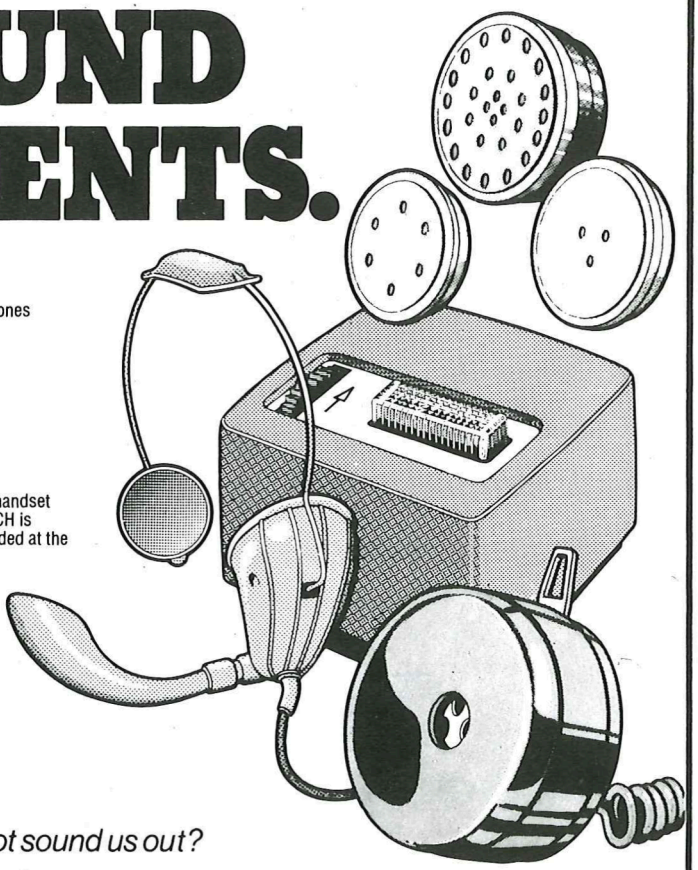

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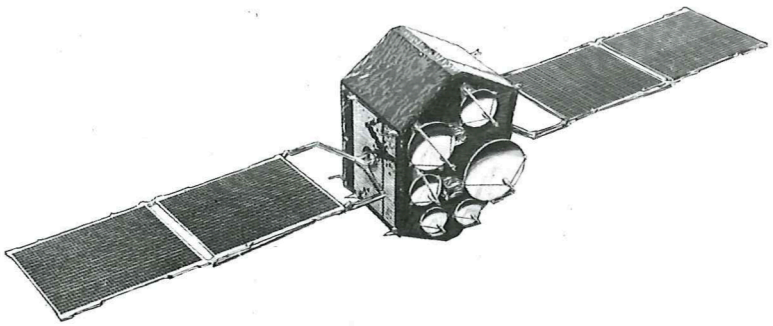

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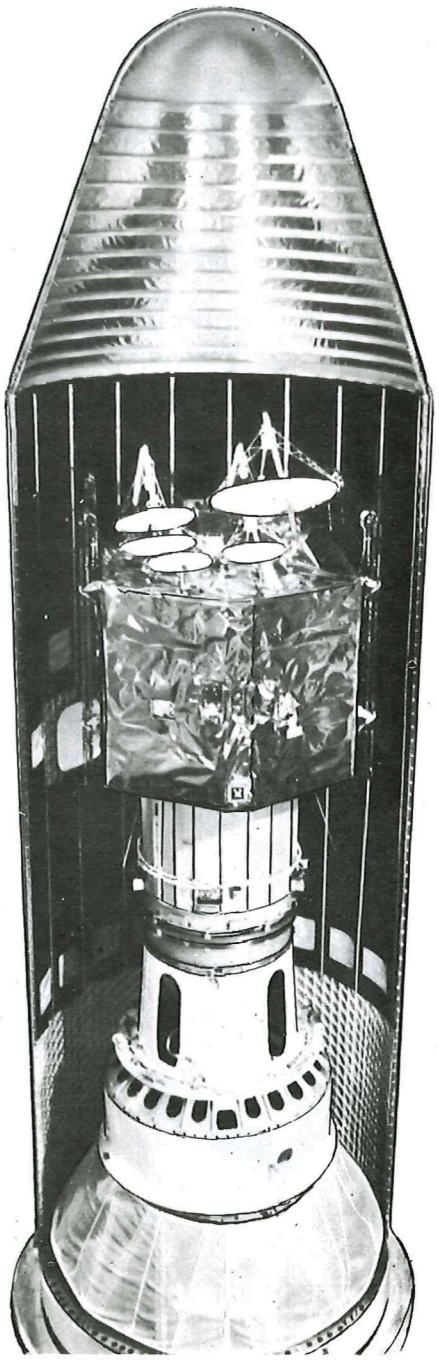

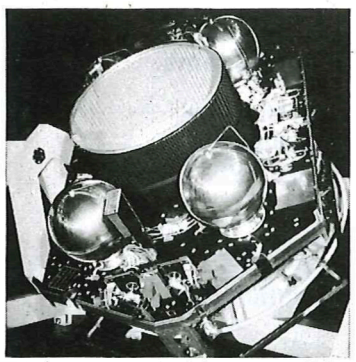

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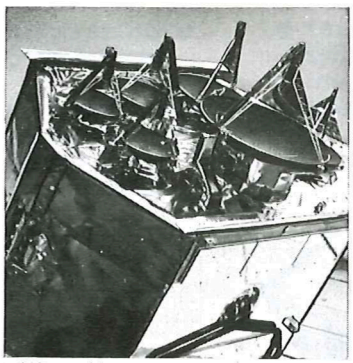

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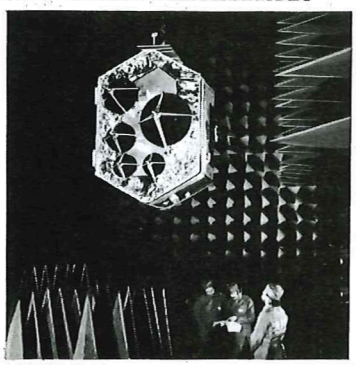

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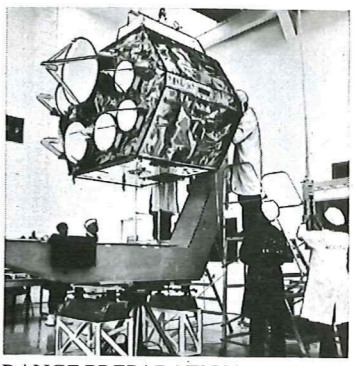

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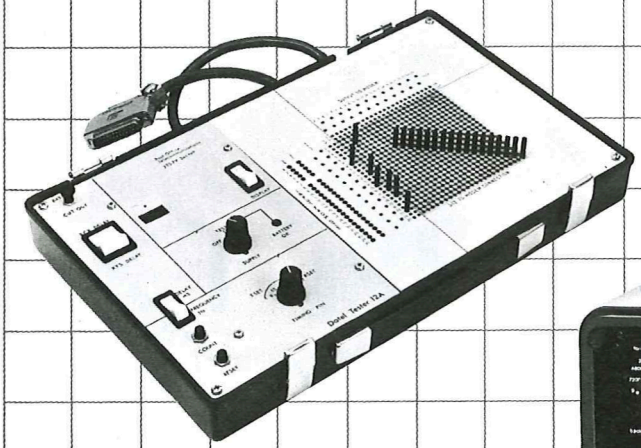

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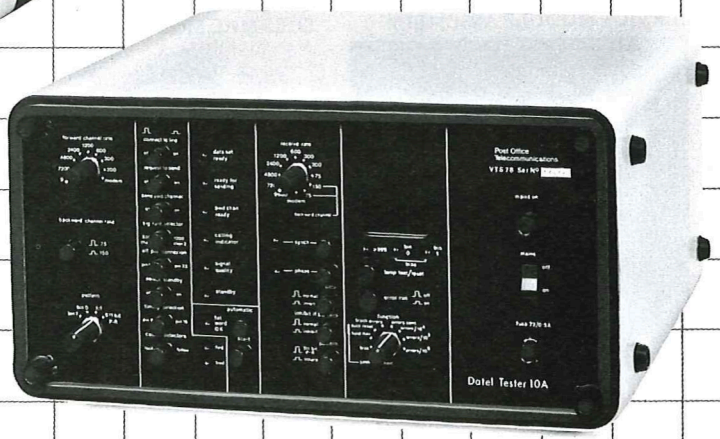

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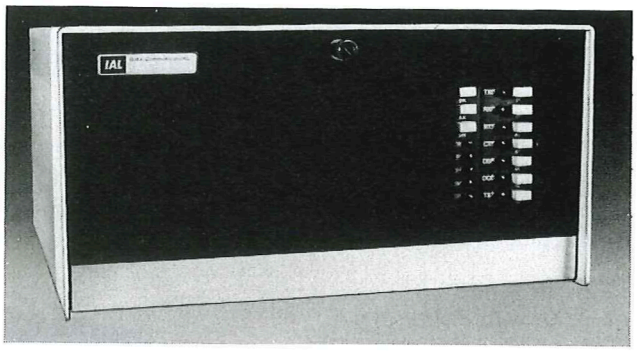

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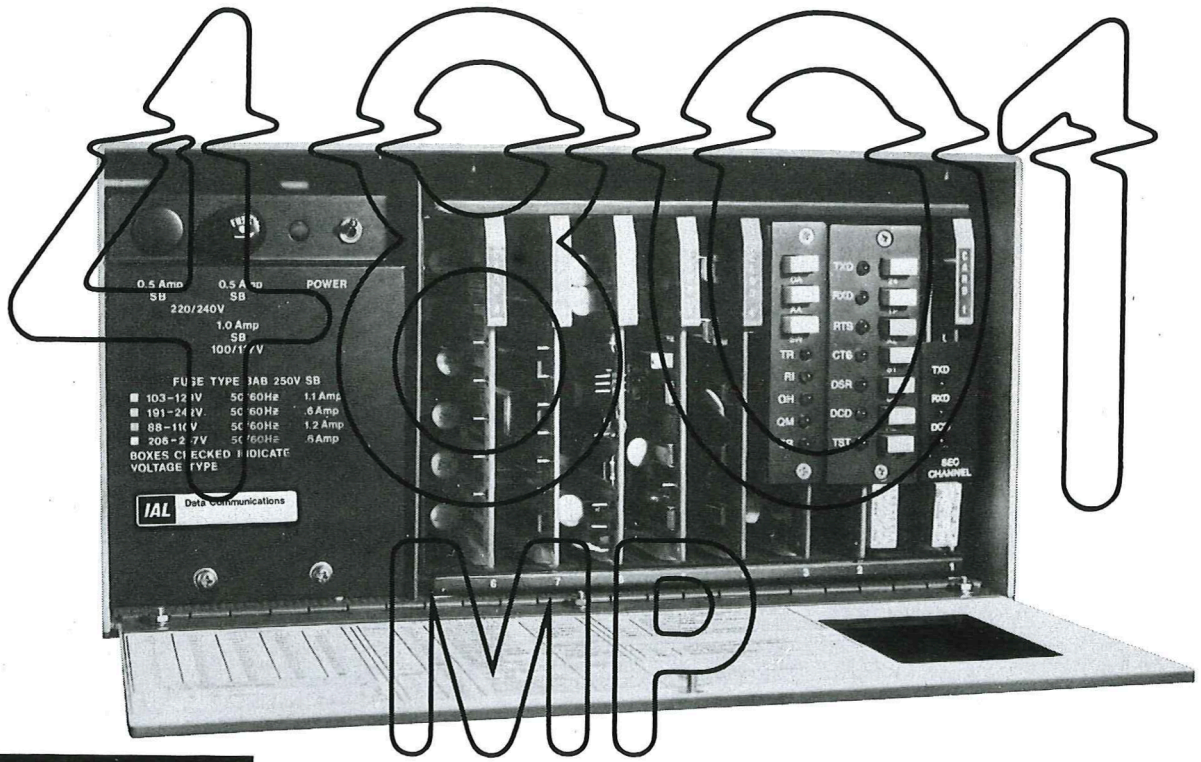

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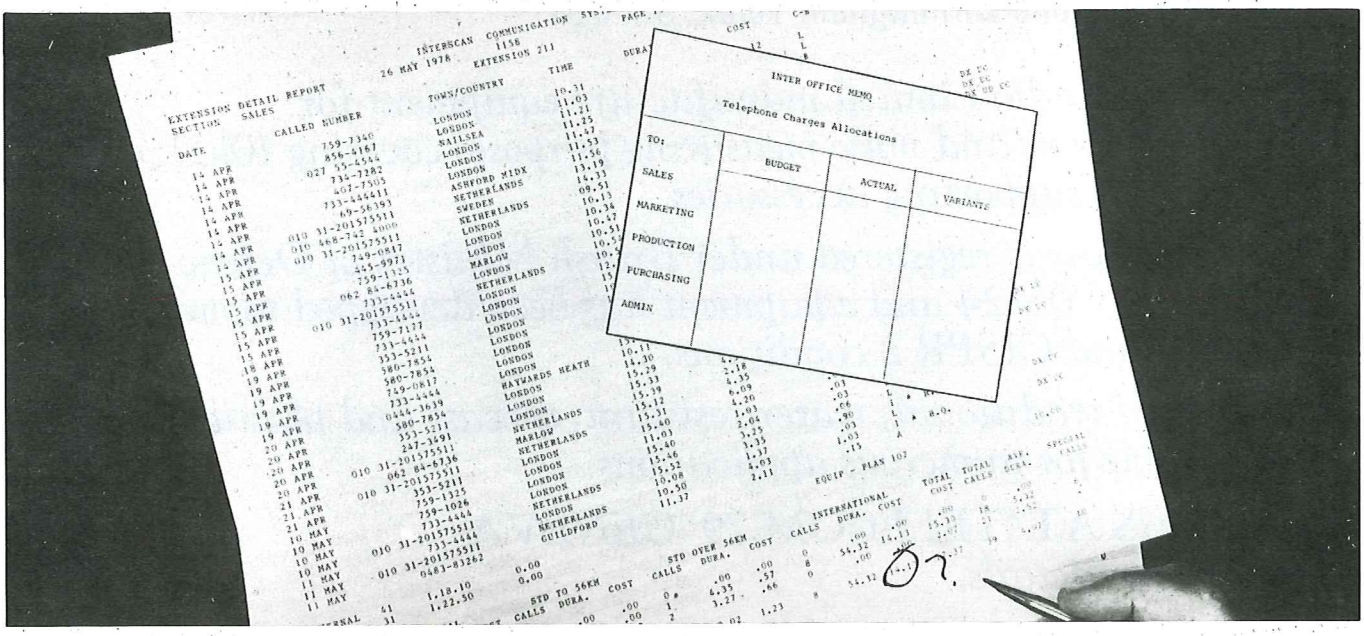

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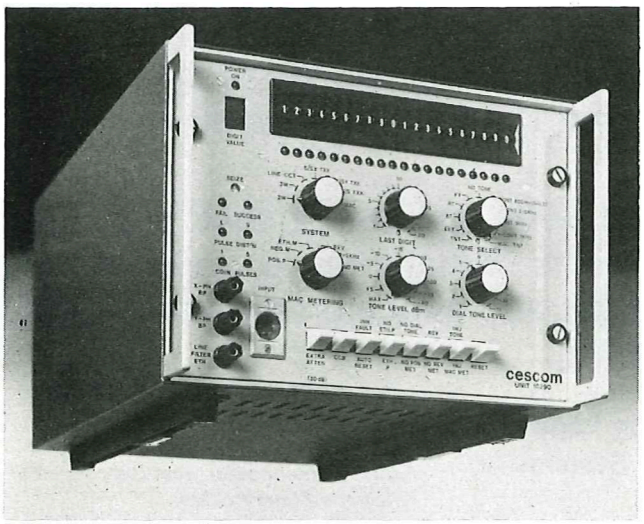

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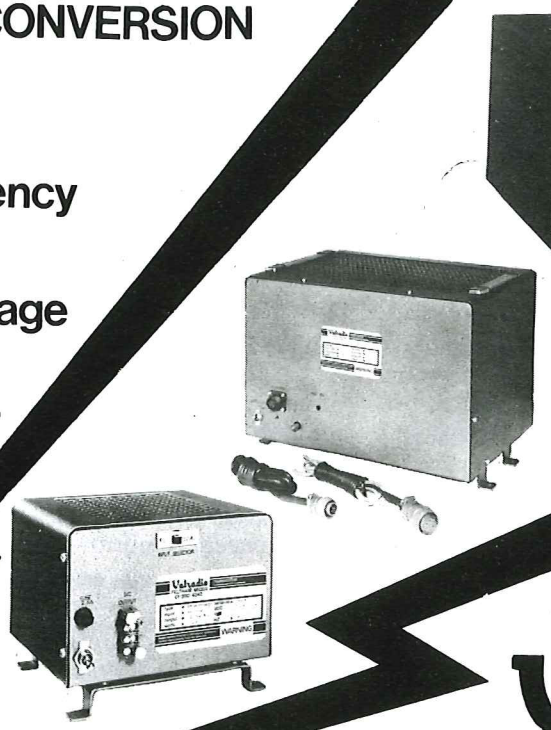

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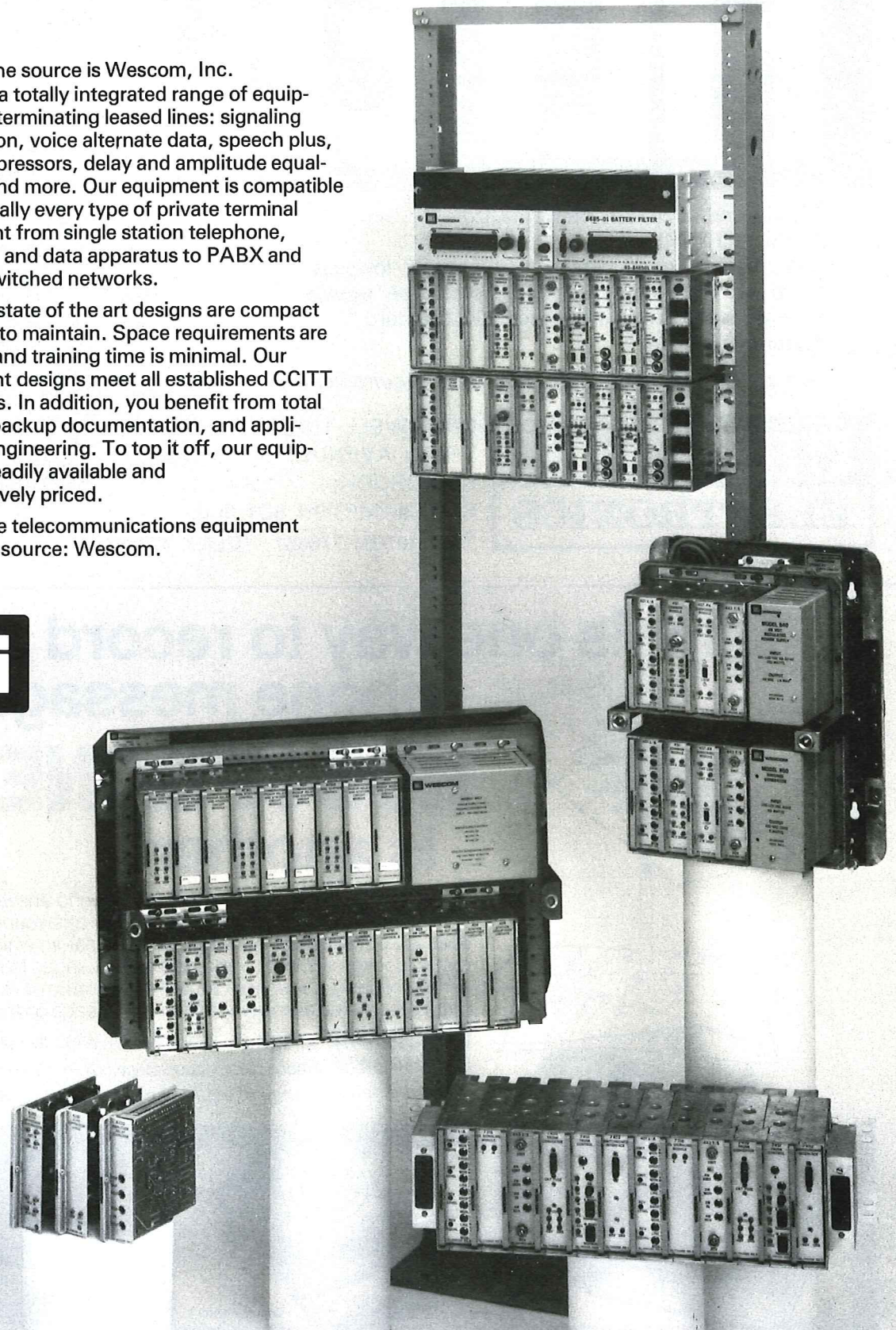

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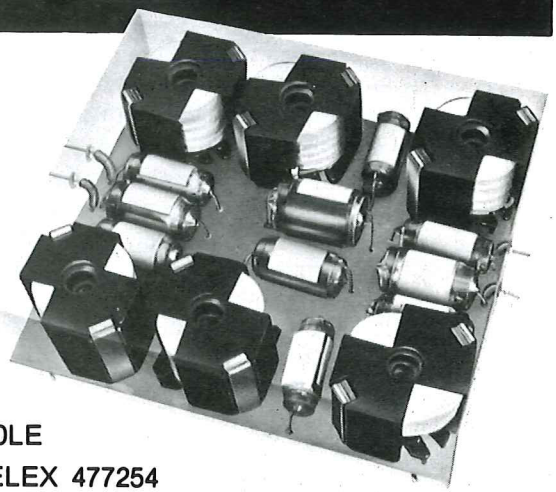

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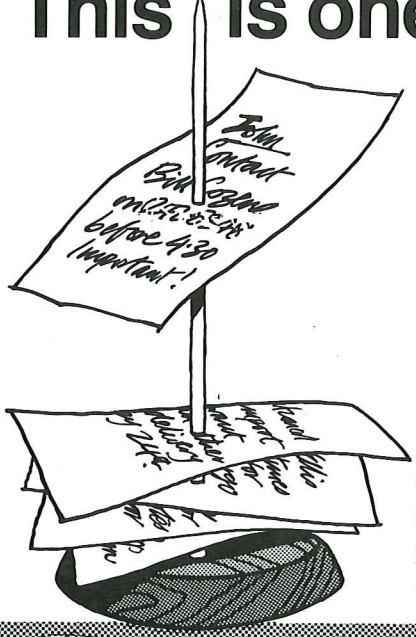

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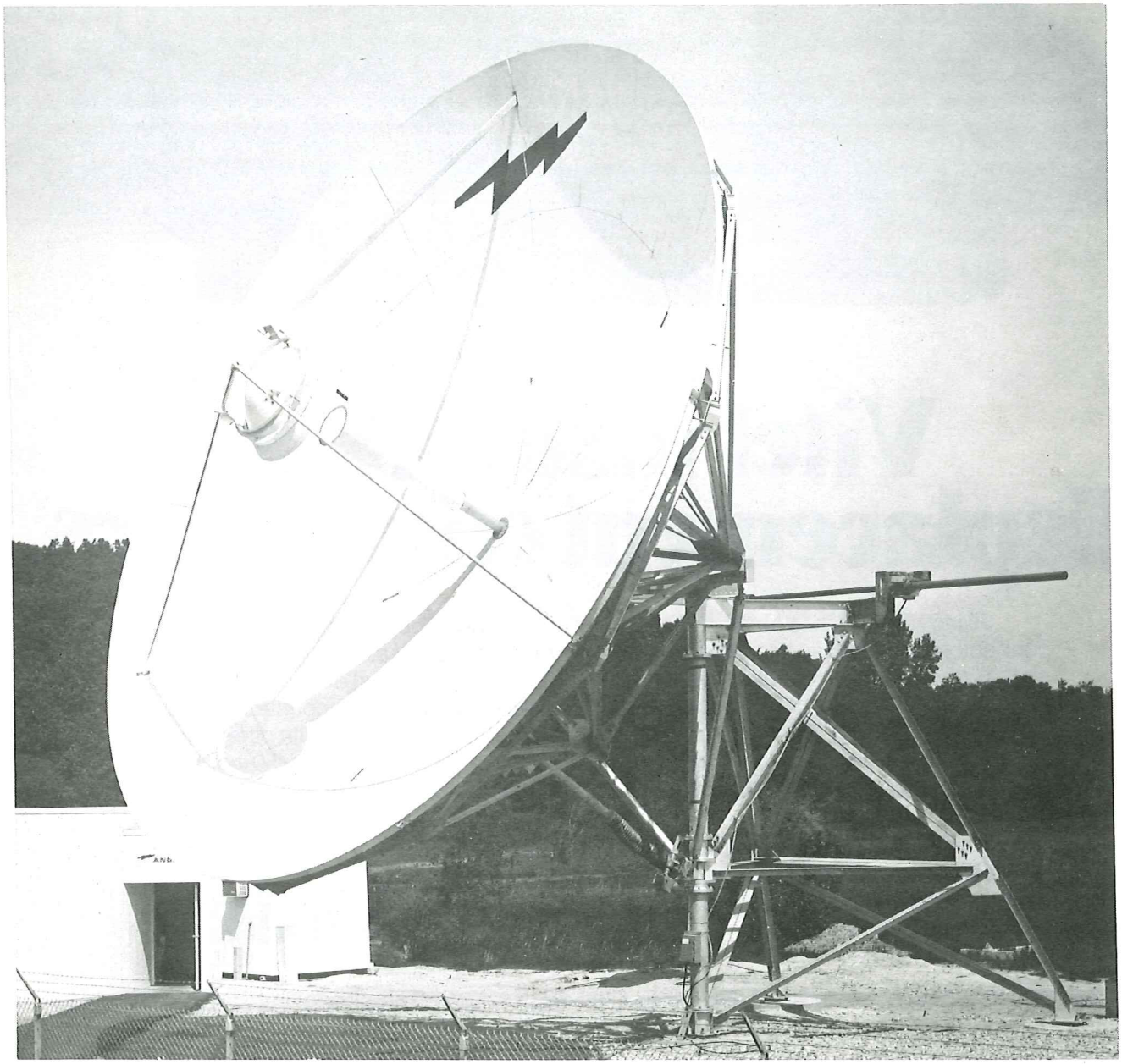

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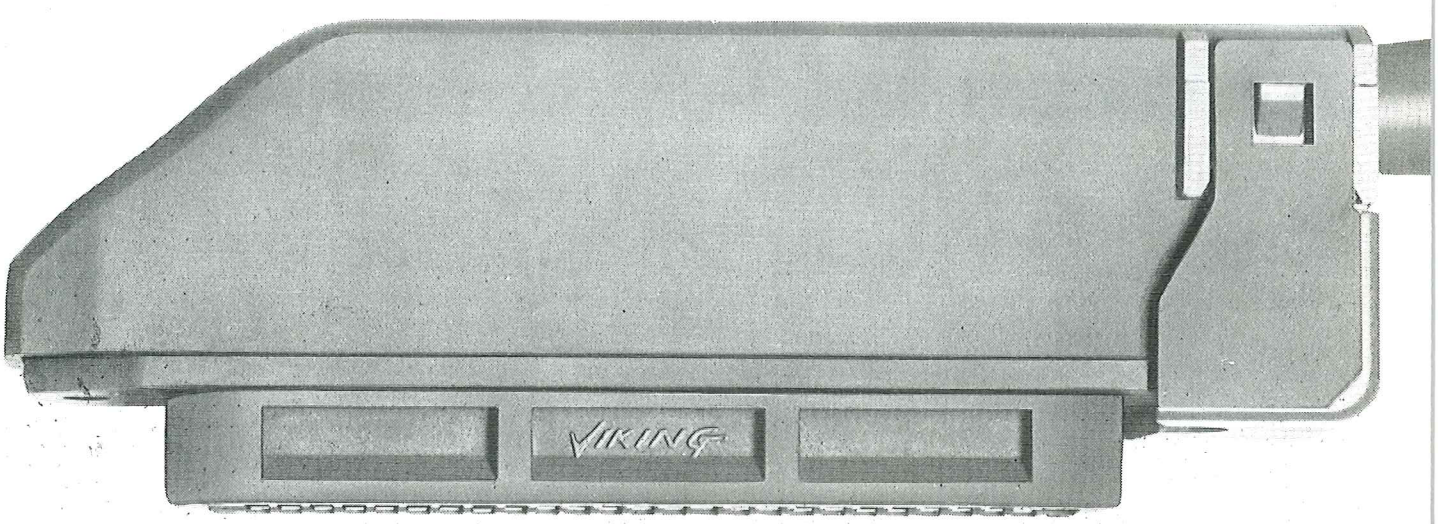

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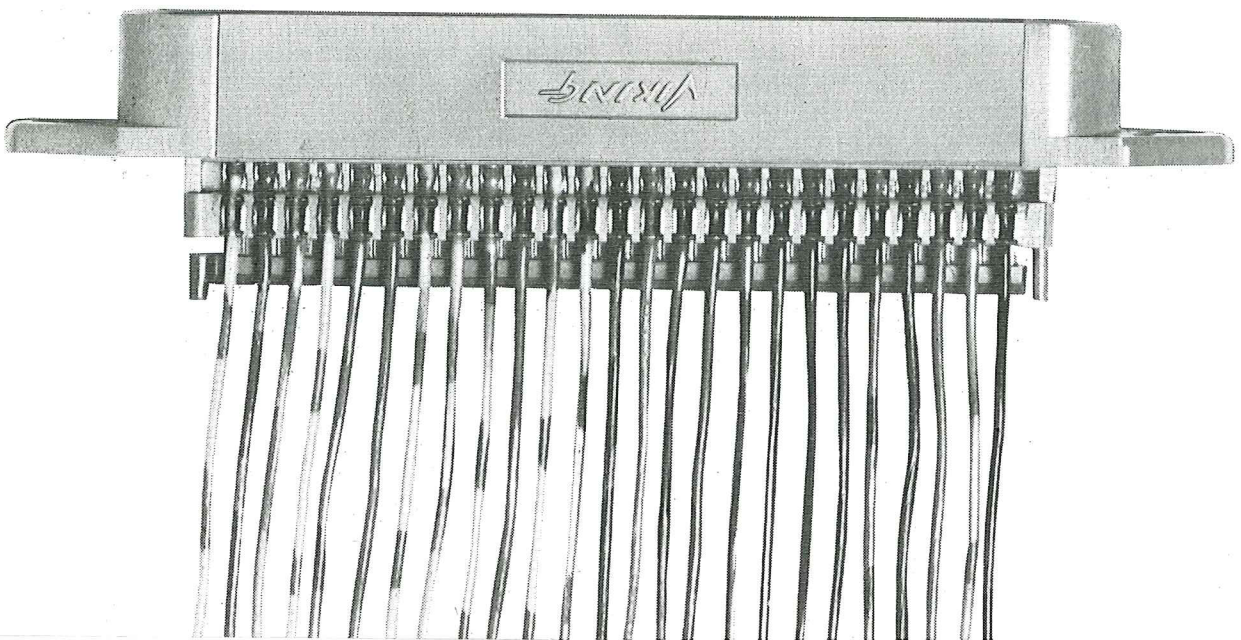

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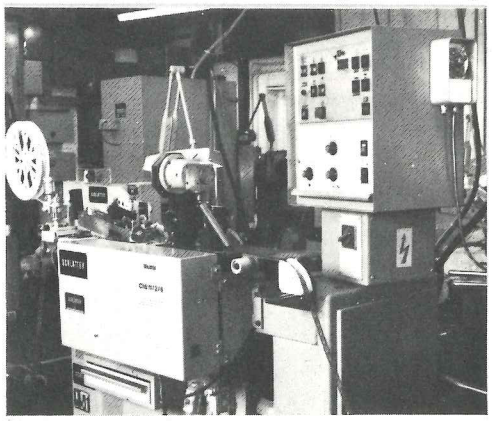

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